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A Weekly Review of Current Progress in Electricity and its Practical Applications

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Vol. VII. NEW YORK, MARCH 6, 1886. No. 10.

THE telephone fiend who wants service at $3 or less a month has again made himself heard in the New York and Massachusetts Legislatures. His utterances do not add to the reputation for wisdom that may be enjoyed by either body.

PROF. SWEET cares so little for underground systems and thinks so highly of electric light that he proposes and has devised a sort of Porta Triumphalis for the effective display of arc lamps and the other features of modern electrical application. His article will be found on the next page.

THE discussion of the subject of insurance of electric lighting plants which took place at Baltimore calls to mind the subject of life insurance of electrical engineers or those engaged in pursuits which bring them in proximity to electric currents of high potential. Recent complaints have been heard in England that electrical engineers have been placed among the "hazardous risks," and they naturally feel that they are not entitled to such a distinction, involving an increased cost of policy. We do not think that our companies have made similar distinctions, and indeed we see not the least necessity therefor. An electrical engineer runs no greater risk than a civil or mechanical engineer, and it is a great injustice to the English electrical fraternity if the course adopted is maintained. One of these days it may be well in this country to extend to the whole electrical fraternity the advantages of such a system of insurance as that developed with eminent success by the Telegraphers' Mutual Benefit Association.

ALL reports concur in speaking of the recent gales as the most severe within a period of at least fifteen years. It is not to be wondered at, therefore, that the wires have here and there sustained great injury; but that as a whole the destruction has been light speaks volumes for the efficiency and trustworthiness of our hard-working friends, the linemen. We have heard of no single serious accident except that in Boston, where a row of half a dozen poles went down together, blocking the street besides hitting some of the houses.

WE are indebted to Mr. A. S. Hathaway, one of Professor Rowland's old students, for a very interesting article in this issue on the armature made by Professor Rowland in 1868–69. The evidence as to the early investigations thus prosecuted in America in an important field of inquiry has never before been made public, and would not now appear but for the pains voluntarily taken by Mr. Hathaway to look the matter up. It is but fair to Professor Rowland to add that the article is published without his knowledge.

CONSIDERABLE curiosity continues to be manifested in the subject of telegraphing to and from moving trains. One of our illustrated articles this week gives detailed information on the various systems for which entire practicability is claimed. The point now to be settled is whether the traveling public will patronize the service sufficiently to make it profitable, or whether its use will be restricted to the railway companies themselves in train dispatching. The belief is confidently expressed in some quarters that the public use will be large at once, and will grow.

SINCE the appearance of Mr. Mordey's paper on electromotors, which we published in a recent issue, numerous correspondents of our foreign contemporaries have come forward to corroborate the facts observed by him, tending to prove that a good dynamo ought not to differ essentially from a good motor, and *vice versa;* and arguing that the point to be observed in the motor is the suppression of Foucault currents. Now that the true path has been pointed out, it is gratifying to know that it had already been entered upon by others; but Mr. Mordey certainly deserves the credit of having first drawn attention to an interesting and important truth.

THE public is now awaiting with some interest the appointment of the Congressional Committee to investigate the Pan-Electric Scandal. It is said that the committee will be composed of five Democrats and four Republicans. Hence, Mr. Garland, being in the hands of his political friends, is not likely to suffer any great injustice, and it is hoped by many in the ranks of both parties that he may be able to present his connection with the Pan-Electric company in a better light than has so far been cast upon it. The general interest in the subject is shown by the great number of cartoons it has called forth. All the weekly illustrated sheets and several of the dailies have employed the pencil of the caricaturist on this occasion.

IN the February number of the *North American Review*, Ouida, in an article under the title of "Some Fallacies of Science," and in reply to the admirable address of Sir Lyon Playfair, makes a bitter attack on modern science as the foe of imagination and poetry, and as a destroyer of human peace and happiness. Taking the electric telegraph as an instance of the "benevolence of science," she affirms that it cannot be said to have made men happier, while it has shortened time only to harass it, has impaired language and manners, has vulgarized death and has increased the great evils of immature choice and hasty action. Our reply to this is a flat denial, and that the telegraph has done good all round. Ouida's utterances on this point are but the echo of Prince Bismarck's, when he complained that the telegraph did not give him opportunity to be unctuous; or of the Boer's, when he told the English intruders on the Transvaal that the telegraph was of no use to him, for if the news was good, it would keep, and if it was bad, he did not want it in a hurry. We take it that everything which can knit a community together, cause a rapid interchange of sentiment and idea, annihilate distance, neutralize isolation and mitigate prejudice is of the greatest good to the largest number, and such a "benevolent" agency we claim the electric telegraph to be.

FROM some newspapers, though not from as many as might be expected, come utterances in support of the technical press as regards the rights of inventors and patentees. Commenting on the late decision in Indiana fixing an arbitrary and absurdly low rate for telephone service, the Boston *Herald* says: "If any one supposes that inventors and inventions are to be encouraged by any such process as this, he possesses but a superficial knowledge of human nature." The Cincinnati *Telegram*, in complimenting Indiana on her "communistic tendencies," as displayed, asks why prices of other things should not be thus fixed, for "with rents reduced to one-half and bread brought down to three cents per loaf, we do not see why there should not be universal happiness reigning." The question involved is not the minor one as to whether the Bell Company or its licensees shall reap the large benefits derivable from an exclusive patent, but the much more important one, whether inventors are or are not to be encouraged by hopes of what they may gain with their talent and perseverance in any line of scientific or mechanical discovery. The splendid prizes found in some patents confer on their holders but an infinitesimal portion of the wealth enjoyed by the country at large as the result of a liberal patent system under which 25,000 patents are taken out every year, the broad, main object of each of which is to cheapen processes of production or to bring some needed convenience within the reach of the community as a whole.

AT last electricity has been brought to aid in the operation of a type-setting machine, and as shown in our article a few numbers back, it bids fair to place that machine upon a firm basis of practicability by removing the objections to which former ones were open. The method employed of perforating a long strip of paper, and then passing that under fingers which close the circuits of electromagnets, reminds one strongly of the Wheatstone automatic system. Indeed, Mr. Munson proposes to perforate his paper by telegraph, so that a dozen newspapers at a time can receive their paper strips ready for the type-setting machine. We should then practically have copy made up in one city, and the ribbon perforated and the type set by telegraph in another. This, if successfully accomplished, would be a great improvement over the present, and the future alone can reveal how our newspapers will be printed 25 or 50 years from to-day. Looking at the present, however, one of the principal benefits to be derived from this method of automatic type-setting will be the great lessening it will cause in the expense and trouble of issuing successive editions of books and other publications, for which it is not generally considered expedient to make electrotype or stereotype plates from which to print them whenever they are needed. And even as to many works that are now printed from such plates, unless it is anticipated that several editions will be required, it may be found cheaper to employ the ribbon to set the type anew for each edition than to incur the expense of making plates.

THE lack of facilities for the proper handling of business in the Patent Office has long been the subject of complaint but without redress. Inventors in the field of electricity have especially been annoyed by this state of things, and to show that their complaints are well founded, we need only refer to the Annual Report of the Commissioner of Patents, recently published. He says that "in view of the rapidly advancing importance of all inventions pertaining to electricity, it seems absolutely indispensable that suitable provision should be made for the proper testing of apparatus relating to this branch of invention. For this purpose within the court of this building the necessary facilities could be provided. *Several times within my incumbency of this office I have been compelled to permit, and have permitted, the examiner in charge of this class to leave his office and go a long distance to witness experiments which could not for want of room and apparatus be attempted at home.*" Here is a state of things which almost challenges belief, and yet the patent commissioner is forced to report it. The placing of such an officer of the government in the position indicated is a direct incentive to malfeasance, and only the well-known integrity of Mr. Kintner would seem to justify such a course. Who pays the examiner's expenses when he is thus forced to travel in order to examine an invention? If it be the government, the expense is unwarranted and the time spent in travel is wasted to the detriment of work in the office. If the applicant for a patent bears the expense, we need not comment further upon this proceeding, except to regret that, under existing conditions at the Patent Office, nothing is left to the examiner, if he would do justice to an inventor, but to pursue the course above-mentioned. Few persons, perhaps, have any idea as to the paltry electrical equipment of the Patent Office, with which it is supposed to examine the operativeness and value of alleged inventions. But recently the entire outfit consisted of ten Bunsen cells, one small hand dynamo, and two small galvanometers of old pattern, without any attachment other than needle circular gradations and binding posts; and all these were presents to the office! That this great country should be compelled to accept presents for the prosecution of abusiness on which it makes a handsome profit is humiliating. In this instance it is shamefully contrary to the spirit of our institutions. The Patent Office, evidently, has favors to bestow, and presents of any kind should be rigidly excluded. We have said enough to show that a state of affairs at the Patent Office has been reached where a halt must be made and a reform instituted.

REVIEWS OF NEW BOOKS.

THUNDER AND LIGHTNING. Translated from the French of W. de Fonvielle. New York. Charles Scribner's Sons. 285 pp. 12 mo. Price, $1.

This book forms one of the series of "Wonders of Man and Nature," and treats of the awe-inspiring and mysterious phenomena of thunder and lightning in an extremely interesting manner. While it is written in a popular style, and is for the most part anecdotal, it also makes the reader intelligently acquainted with the cause and effects of the phenomena. The work is handsomely bound and profusely illustrated.

WONDERS OF ACOUSTICS. Translated from the French of Rodolphe Rodan. With an additional chapter on the reproduction and transmission of articulate speech (by electricity). New York. C. Scribner's Sons. 1886. 12 mo. Price, $1.

This a companion volume to the above, and its title sufficiently explains its contents. The additional chapter is a valuable supplement to the original matter, especially at a time when electricians are giving so much attention to the study of sound. The illustrations are numerous.

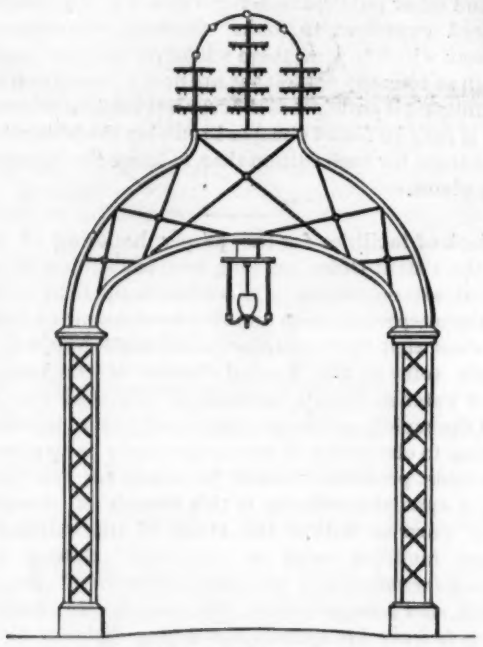
PROCEEDINGS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION. The First Annual Convention, February, 1885, at Chicago, and Semi-Annual Convention, August, 1885, at New York. Published at the office of the Secretary, Baltimore, 1886.

The record of these two meetings is one which may well be embodied in lasting shape, as they may be said to have laid the foundation of an association whose importance, while realized even now, will in all probability be much greater in the future. The full reports of these meetings have appeared in THE ELECTRICAL WORLD, and we can only add that in their collected and officially revised form the proceedings make very interesting reading. We might criticise a few points in the editorship of the publication, but abstain in the belief that the shortcomings result from novelty and a natural lack of experience, and are less and less likely to be apparent as the Association adds to its series of reports.

A New Plan of Running Overhead Wires.

BY PROF. JOHN E. SWEET.

It is evident from the discussion on the question of underground wires at the convention of the National Electric



ARCH FOR STREET ELECTRIC LIGHTING.

Light Association, that it will be a long time before the system will be universal in our smaller inland cities, and it is also equally evident that the present poles, various in height and numerous in distribution, are not agreeable things to look at. Nor are the wires strung along in front of the buildings satisfactory to those whose premises they encumber, nor pleasant to deal with in case of fire. I wish to present the following scheme as a substitute or compromise—not that it will be equal to the underground system for the people, nor as cheap for the companies as the poles; but it is something that presents no electrical objections and would certainly be less objectionable than the poles, and with a proper expenditure of money can be made, of the two, rather a street embellishment.

The plan in its crude form is shown by the sketch herewith, and consists of light lattice iron posts at the curbstones along the street, at convenient or necessary intervals. From the tops of these posts light lattice iron arches are sprung, either Gothic, semi-circular or semi-elliptical, according to the width of the street. Upon the crown of these arches are to be erected the necessary posts and brackets for the telegraph lines. Below the crown of the arch the electric light wires are to be situated, and along the tops of the columns the telephone wires, as far as possible from the others. This admits the telephone wires when they would be in the way in case of fire, but no great trouble or serious harm would come from breaking them down.

Such a series of arches along a street, if graceful in form and well executed, could not be unsightly. The wires would be as much out of the way as is possible, and above ground. With properly designed columns or posts and arches, there would be a ready means of reaching every wire by the linemen and lamp-trimmers, without ladder or creepers. The posts and arches are to be formed of four principal members, and be two feet or two and a half feet in the direction parallel with the street. The lattice bracing on the inside is to form a ladder up the post and runway over the arch. There are a number of minor details I have thought out, but a description of them is not necessary to an understanding of the scheme.

An Unwritten Chapter in the History of the Dynamo.

BY ARTHUR S. HATHAWAY, LATE FELLOW IN MATHEMATICS OF JOHNS HOPKINS UNIVERSITY.

More than a year ago I found in Prof. H. A. Rowland's library, to which I had access, at Johns Hopkins University, some very interesting information in regard to the dynamo-

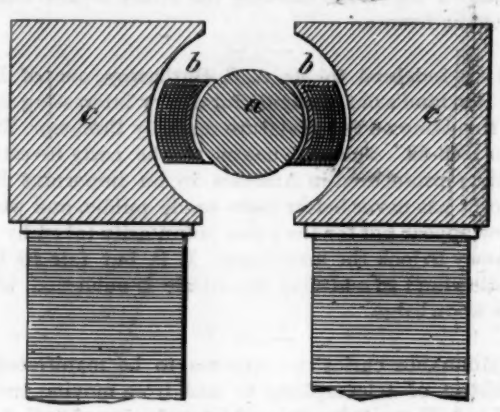


FIG. 1.—THE ROWLAND ARMATURE.

electric armature made by Professor Rowland in 1868–9, and quietly exhibited by him at the Electrical Exhibition in Philadelphia in 1884. Now that the visit of the National Electric Light Association to Baltimore—where it was seen at the University by many members of that body—has directed attention again to the subject, I think it well to give the information to the electrical public, through the columns of THE ELECTRICAL WORLD, and thus secure for Professor Rowland the credit that may be his due as to priority in an important field of research and investigation. I have simply added reference figures for the illustrations.

I found it in a book "used while a student in the Newark Polytechnic Institute, 1868." Under date of August, 1868, is the following:

"Magneto-Electric Machines."

"In all forms of these machines yet made, a revolvable armature of iron is used. Now, it is well known that a large portion of the power used to drive these machines is absorbed in producing heat and currents of electricity in these armatures; therefore, I propose either to form them with wire, or dispense with them altogether. The figure (Figs. 1 and 2) shows an arrangement for effecting the latter.

"The armature *a* is held stationary, while the coil *b b* revolves around it, thus cutting lines of magnetic force. By this arrangement, all the power will be used to produce a current in the coil, while the ordinary form the armature has to be magnetized and demagnetized rapidly, thus absorbing power. This arises from the resistance of iron to becoming a magnet, and is well illustrated by various experiments on suspending an iron disc between the poles of a magnet; the disc has one edge weighted, and the resistance is ascertained by the time the disc takes to decrease its arc of vibration a certain quantity.

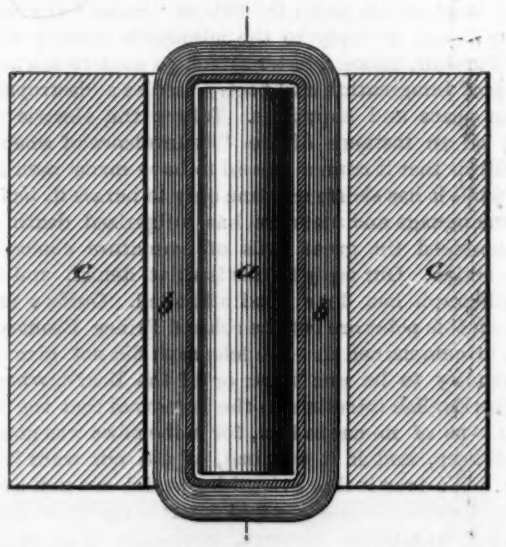


FIG. 2.—THE ROWLAND ARMATURE.

"Let the figure (Fig. 3) represent a cylinder of iron between the poles of a magnet. When it is not revolving *N* and *S* will be the induced poles; but now let it turn in the direction of the arrow, and now the induced poles, instead of being at *N* and *S* will be carried to *N'* and *S'*, on account of the time taken for iron to become magnetized and demagnetized. This position of the poles will oppose a resistance to the motion, which will become greater as the velocity is accelerated. Besides this resistance of the cylinder as a magnetic metal, there is another due to the iron as a conductor. When the cylinder is revolved, currents of electricity flow as seen in the figure (Fig. 4).

"These tend to cause the conductor to revolve around the poles in an opposite direction to that of rotation, and thus oppose a resistance. These two resistances (which form by far the greater part) are both got rid of by using the apparatus as described above."

The book from which this quotation is taken has on its title-page:

NOTE BOOK
FOR ADVANCEMENT IN KNOWLEDGE, ETC.
NO. II.
UNREVISED EDITION.
Try, Try Again.

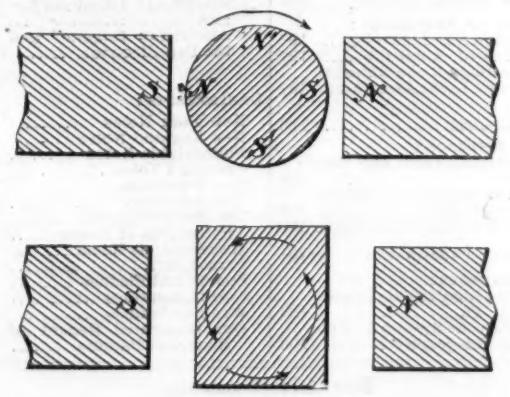
"Some, I think at this date, are good, others moderate and some bad. But I have put all into the volume because of the utility they have been to me—and none more than the bad—in pointing out to me for future, or rather, after time, the faults it became me to watch and avoid."—*Faraday.*

In the winter of 1868–9 the armature above described was constructed with six coils. There are two windings, one for the magnet, and the other for the external circuit. Every coil makes a circuit by itself; there is only one coil in circuit at a time. This has one advantage, viz., by putting different brushes on the armature one can take off as many currents as one pleases, from the same armature. Gramme's first machine was constructed in 1870 and Siemens' still later, so that this is an armature giving a continuous current antedating nearly two years other continuous current armatures. The armature was on exhibition, as I have said, at the Philadelphia Electrical Exhibition, September, 1884. In the actual armature, the inner core (*a*) has freedom of motion, so that it may move or not as it wants to; but the coils *b b* revolve around it. This is what Siemens first did, until he made use of discs, and so got over the difficulty.

Electric Lighting at Lynchburg, Va.

We have received a copy of the local official report on the operations of the Piedmont Electric Illuminating Company of Lynchburg, Va., a licensee of the Brooklyn Electric Construction Company, controlling the Knowles-Moffatt system of arc lighting. The company encountered a great many obstacles in starting the plant, but have, it will be seen, overcome them all. The report is made by Mr. Krise, chairman of the City Council Committee on Light:

Your committee gladly testify to the wisdom of the Council in undertaking to modernize the system of lighting your city. We are gratified to report that the operation of the new system has been more successful than our



FIGS. 3 AND 4.—THE ROWLAND ARMATURE.

greatest hopes ever anticipated. Pardon our elation over this achievement. As in all cities, the main business streets and thoroughfares are more thoroughly lighted than those less frequented or more sparsely settled. Your committee, while conscientiously keeping within bounds of economy, has endeavored to distribute light to benefit all. While there may be some isolated places, which on account of their position or topography have no light, yet we have tried to dispel at least utter darkness from all inhabited parts of the corporation. In doing this we will incur a greater monthly outlay than we at first anticipated. It will be remembered that only a small part of the city was heretofore lighted, and thus manifest injustice was done a large proportion of the taxpayers.

By the advantageous contract, you have succeeded in obtaining, at about half cost, a better light than many of the Northern cities, as we have been assured by those who have had an opportunity to judge. The electric light was not in regular operation until September of last year. Since that time there have been no interruptions, except on two very cold nights, when the ice impeded the turning of the wheels that generate power. This, of course, could not be prevented, and it may not occur again in a generation.

We have now in operation 126 lights, extending over the whole city, except that part west of Pierce street known as Camp Davis. Having erected a tower in the new reservoir with good effect, we are now placing one at Thirteenth and Pearl streets, which manner of lighting will save three lights as usually distributed. This will

make 130 lights, which we hope will suffice for the present; of course, if any more are necessary, it will be brought by petition before the Council. It may be well to consider the cost of electricity as compared with gas. To do this we will have to approximate the corporation areas illuminated, which will be difficult to do. Dr. Dulaney and others think only one-third of the city was lighted before. If we assume it at one-third as against the whole corporation now, the comparison will be as follows: Gas for fiscal year ending February, 1885 (deducting for public buildings) was $7,610; at the same rate for the whole city would be $22,830. Our estimate for 130 lights is $14,000, which is $8,830 in favor of electric lights. We leave an intelligent and appreciative community to draw the comparison between the different systems. On this point, however, we will quote Chief Irwin, who thus contrasts the two. He says:

P. A. Krise, Esq., Chairman:

You ask my opinion as to the illumination of the city by electricity as compared with the same by gas. In answer, I will say electricity is *incomparably* superior, and in support of my answer give the following reasons:

First. The electric lamps, as now situated, with but little exception, embrace the entire area of the city.

Second. The light of the electric lamp being so great, the entire space between the lamps is sufficiently lighted for all practicable purposes; with the gas it was quite different.

Third. The lamps being on poles from thirty-five to forty feet above the ground, in many instances, not only are the streets lighted, but courts and back yards of residences and other buildings, thus enabling the police while on a tour of inspection of their beats, to thoroughly inspect the above places, and thereby prevent the commission of theft and other crimes that are common to dark places in a city. As further reasons for preferring the present system of illumination, the city now pays for what *it gets* in the way of light, whereas under the gas system it was paying for about 175 lamps each night, when there was an average each night of at least ten of the 175 that refused to burn at all, and others gave little or no light.

[Signed] J. M. IRWIN, Chief of Police.

Not alone for this municipality does electricity shed its effulgent beams, but its beneficent rays overleap her bounds to delight our suburban neighbors, as is shown by the following communication:

* * * * * * *

There followed a number of letters from people residing in the suburbs, all congratulating the committee and the city, and returning thanks for the beautiful and far-reaching light furnished them without cost.

The Parcelle System of Multiple Telegraphy.

A new system of multiple telegraphy, based on the invention of Mr. Albert L. Parcelle, of Boston, has recently attracted much attention from electricians and telegraph men. While using the two arms revolving in unison over two circular tables of contacts at the two ends of the line, as has been done in the attempts to accomplish multiple telegraphy, the other features of this system are said to be so radically new as to be of considerable public interest in view of the end aimed at.

The essential points in a multiple telegraph system are, first, to provide two motors capable of running very closely together and thus keeping the revolving arms at the two stations very nearly in unison; and, secondly, to provide an absolutely reliable means of correcting the arms when one gets ahead of the other and bringing them into unison again. The first point is gained by using as the motors for the two arms two strips of brass, called reeds, with armatures on the end, driven electrically; two reeds of exactly the same dimensions, as is well known, will have exactly the same rate of vibration and will, therefore, keep time with each other regardless of the amount of current used. Heretofore, reeds have been used merely as circuit breakers; but, in this system, they are driven in an entirely novel manner, which makes it possible to drive the revolving arm by direct mechanical action from the reed by means of an anchor lever and ratchet wheel. The next point, after securing approximate uniformity in the movement of the arms, is to provide for correcting them when the slight variations which are inevitable occur. The advantage clhimed is that it accomplishes this by a positive movement that cannot fail. When one arm is in advance of the other it abuts against a detent lying in its path; this forms a circuit which holds the reed firmly at one end of its swing, where it remains until the other arm catches up, when it is released and starts off again at its regular rate of vibration, this process being repeated as often as necessary.

The work of building the machine has thus far been carried on in New York City under the direction of the National Electric Company, formed here to control the inventions for the United States; but a new company has just been organized to work the inventions in Europe, having on its board of directors a number of well-known Boston men; and work for that company also is now being carried forward.

The inventions have many important applications besides the multiple telegraph. The extension of long-distance telephony makes them, it is thought, of much importance in the telephonic field. The method of driving a reed has been applied also with great success to the pendulum of a clock, thus dispensing entirely with the spring and train and making, it is claimed, a time-piece of great simplicity, cheapness and accuracy, run locally by a single cell of gravity battery. A clock has been completed and has been exhibited in successful operation here for several months, where it has attracted much notice. These inventions cover likewise new forms of printing telegraphs and stock reporters, said to be simple and cheaper of construction and more reliable in operation than any yet devised.

The names subjoined show the character and standing of persons composing the company: President, William F. Drake, Supt. N. Y. Stock Exchange; Vice-President, Henry E. Alexander, Latham, Alexander & Co.; Treasurer, Charles C. Allen, Member N. Y. Stock Exchange. The above, with Josiah Quincy, attorney-at-law, Boston, and Albert A. Drake, member N. Y. Stock Exchange, constitute the full board of directors.

The Various Methods of Telegraphing to and from Moving Trains.

The widespread interest manifested in the subject of telegraphic communication with moving trains may be

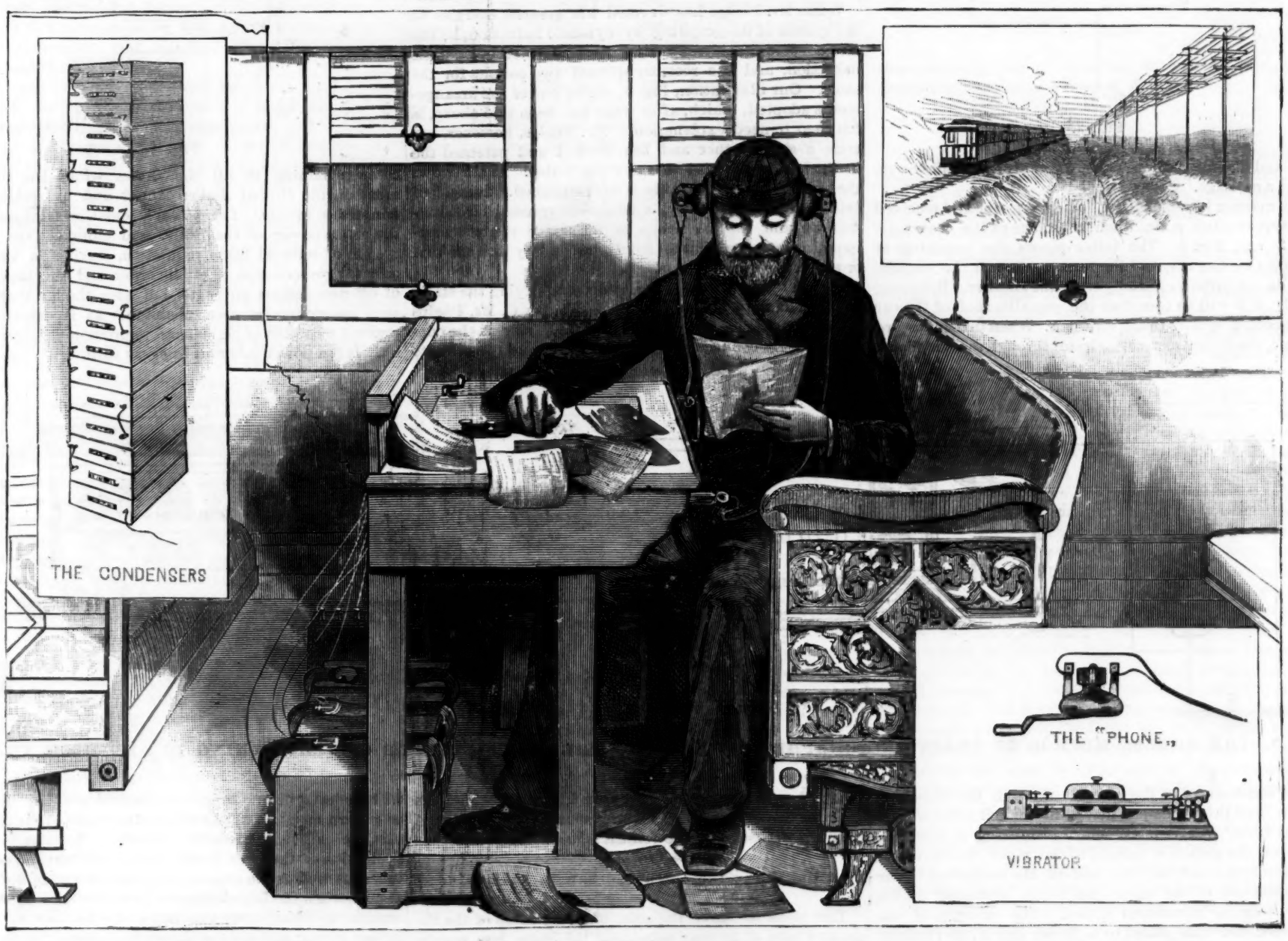


FIG. 1.—EDISON SYSTEM OF TELEGRAPHING TO AND FROM MOVING TRAINS—THE OPERATOR IN THE CAR.

said to have originated with the successful operation of the Phelps system on a part of the New York, New Haven & Hartford Railroad. It is now a year since that section of the road was equipped as then described and illustrated by us, and the service has been in continual daily operation, only recently averting a possible accident by informing the conductor of a moving train that several cars had broken loose from a train ahead, and warning him to be on his guard for them.

The Phelps system, which we fully described in our issue of Feb. 21, 1885, is based upon the *dynamic* induction between adjacent wires, and, as will be remembered, employs a conductor running along the track, the current through which induces a corresponding one in a coil upon the car.

Several years ago, however, it occurred to Mr. Wm. W. Smith that *static* induction could be employed for the same purpose, and he proceeded so far as to take out a patent on such a method. He went no further, however, and nothing was done with the idea until Mr. Edison and Mr. E. T. Gilliland took hold of it and developed it in such a manner that the recent results obtained on the Staten Island Railroad were made possible. As stated above, the effects are produced by *static* induction. The metal roofs of the cars being charged, they act inductively upon the telegraph wires on the adjacent poles, and these being suitably connected with receiving apparatus at the terminal station, make communication possible. Similarly

by charging the wires, the roof of the cars is acted upon inductively, and in this way communication in the reverse direction is made.

The arrangements of the car and the terminal station are quite simple, and consist of a telephone receiver in lieu of a sounder, a Morse key, a vibrator, and an induction coil. Our illustration, Fig. 1, shows the operator seated at his desk, which has been installed in one of the passenger

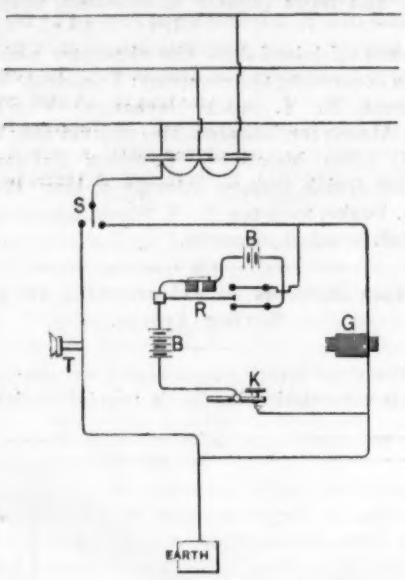


FIG. 2.

cars, and having two telephones to his ears while he receives a message.

The manner in which the messages are sent and received will appear quite plain upon reference to the diagrams, Fig. 2 and Fig. 3. The latter shows the apparatus as arranged on the car, and the former, that at the station: they do not differ materially from one another. Referring to Fig. 3, it will be seen that the metallic roof of the car is connected by wire to the switch *S*. When turned toward the left, the switch closes the circuit through the telephone, which is connected to the ground through the wheels of the car, and this is the position of the switch when a message is being received. When transmitting a message, however, the switch is turned to the right, which closes the circuit through the one end of the secondary of the induction coil *G*, the other end being grounded in the same way as mentioned above. The primary of the induction coil *G*, is joined to a Morse key *K*, and battery *B*, and interposed in the circuit is the vibrator *R*. When the switch *S* is turned, the vibrator is started, so that when the key is pressed the primary coil of *G* has a series of rapidly intermittent currents sent through it. The secondary of *G* being connected to the roof of the car, it consequently sends into the latter a series of rapidly intermittent charges of high potential. These react upon the telegraph wires and influence the condensers attached to the lines at the terminal station shown in Fig. 2. Here it will be noticed the condensers are coupled in parallel, one side of each being joined to a wire and the other to the leading-in wire. The rapidly alternating charges produced by the vibrator are received in the telephone as a series of "buzzes," or a musical note, the duration of which depends, of course, upon the length of time the key is pressed. In this way the dots and dashes are received as short and long notes.

While all the actions between the wire and roof seem to be well explained by the principle of static inductive action, Mr. Edison claims to have discovered a fact which adds to the facility of this mode of communication. He asserts that there is an actual *discharge*, or, in other words, a current between the roof of the car and the telegraph wires. He bases this assertion upon the theory that for an exceedingly small fraction of a second the air is a conductor for an electric current; but that as soon as the air has become polarized by the passage of the current its resistance increases and it ceases to conduct. Hence the rapid charges permit the air to become alternately neutral and polarized, or conducting and non-conducting.

Besides the method of employing condensers at the terminal station, as shown in Fig. 2, another method of receiving the impulses has been devised. It consists in joining the main line to the primary of an induction coil *C*, and connecting the secondary with the instrument circuit. In Fig. 4 three lines are shown joined up in this manner. At the recent trials on Staten Island four telegraph wires were used in transmission, and the roofs of several cars were connected so as to expose a large surface to inductive action, but under favorable circumstances the number of wires and roofs can be reduced.

In this system the wires used are employed as usual in the regular business of commercial telegraphy, and the question naturally arises, how is it that the currents passing over the wires do not affect the telephone and hence interfere with the message to or from the car. This is explained by the fact that a comparatively slow make and break in the circuit, such as would be made in the manipulation of the Morse key, makes a *gradual* deflection of the telephone diaphragm, without causing a sound. But the rapid and sudden breaks caused by the vibrator, influence the diaphragm so as to make it emit a musical note. The effect is similar to that in the Van Rysselbergh system of simultaneous telegraphing and telephoning over the same wire.

While Mr. Phelps has devoted his greatest energies to the system of telegraphing by dynamic induction, he has also devoted considerable attention to the method of static induction, and has recently secured two patents for the same. Our illustration, Fig. 5, shows one of the arrangements adopted, which, after what has been said above, is too clear to need explanation. Mr. Phelps, however, has gone a step further and has devised and patented the method of *telephoning* to and from trains. Fig. 6 shows the manner in which this is accomplished. Instead of employing the Morse key, a telephone transmitter is substituted, and the variations in resistance throw corresponding varying charges from the battery into the roof or the wires, as the case may be.

For the purpose of still further amplifying the static changes of condition in the line-conductor *C*, Mr. Phelps interposes the condenser *F* therein, one pole of the condenser being connected to the conductor and the other to the earth. By this means it is found in practice that the effect of any battery or electric source at the station *A* upon the apparatus in the vehicle is markedly increased.

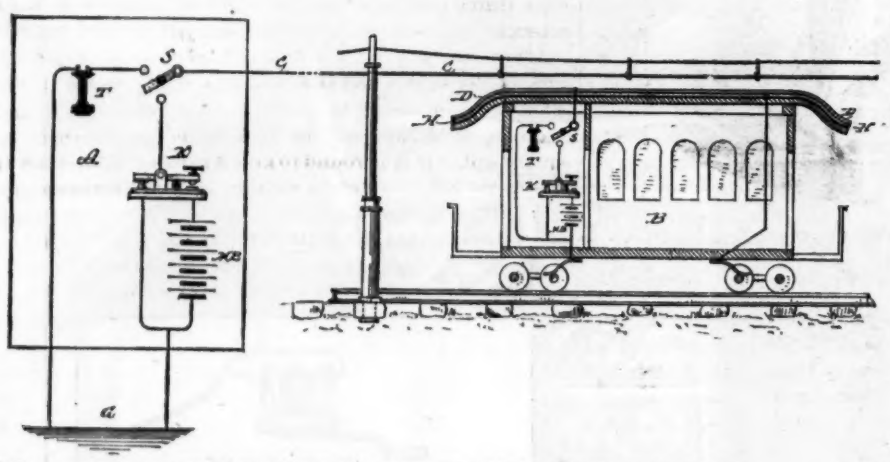


FIG. 5.—THE PHELPS METHOD OF TRAIN TELEGRAPHING.

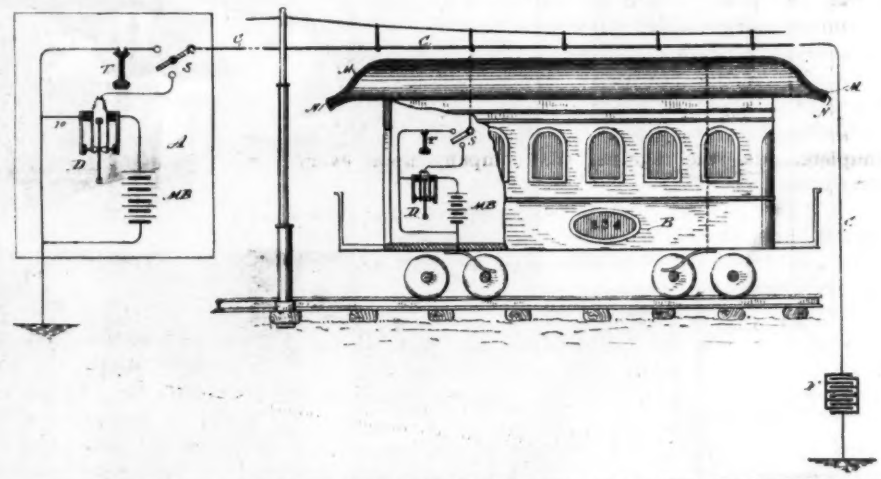


FIG. 6.—THE PHELPS METHOD OF TELEPHONING TO AND FROM TRAINS.

Upholding the Telephone Law in Indiana.

Last week we gave the point of the decision of the Supreme Court of Indiana upholding the State law regulating telephone rates and reducing them to $3 a month. We are now able to give the text more fully. In effect the

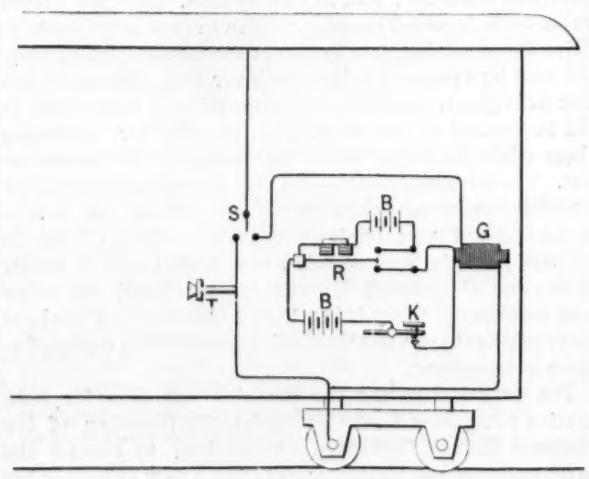


FIG. 3.

decision is that the law is constitutional, and that the extra charges above $3 a month made by the company, for alleged service, are illegal, as by the word "telephone" the law meant all the appliances in connection with the service. The opinion in the case (State *vs.* John E. Hocket) was written by Chief Justice Niblack, who rules against the company on all points raised, and all the other judges concurred. On the point raised by the appellant that, as the various articles used in the telephone service were all patented under the laws of the United States, the Legislature of a State had no power to limit the price, use, sale, or rental value of such articles, and that as a consequence, all acts of a State Legislature of the class to which the present law belongs, are inoperative and ineffective, the opinion says:

The ready and indeed inevitable answer is that the question thus presented ought no longer to be regarded as an open question. There is a reserved and at the same time well recognized power affecting their domestic con-

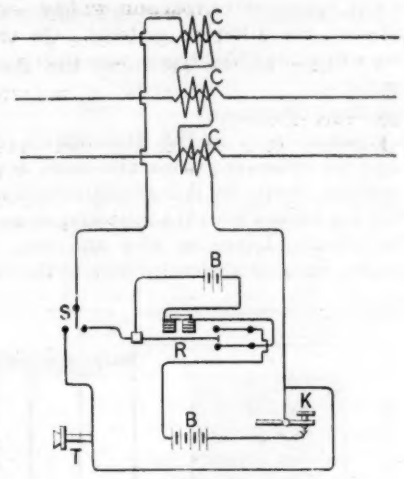


FIG. 4.

cerns remaining in all the States which the Government of the United States cannot and has seldom attempted to invade. This power is sometimes denominated the police power of the State, and embraces the entire system of internal State regulation, having in view not only the preservation of public order and the prevention of offenses against the State, but also the promotion of such intercourse between inhabitants as is calculated to prevent a conflict of rights, and to promote the interests of all. It is a power inherent in every sovereignty, and is, in its broadest sense, nothing more than the power of the State to govern men and things within the limits of its own dominion. (License cases 46, U. S. 582.) It extends to the protection of the lives, limbs, health, comfort and convenience, as well as the property of persons within the State. It authorizes the Legislature to prescribe the mode and manner in which every one may so use his own as not to injure others, and to do whatever is necessary to promote the public welfare, not inconsistent with its own organic law. (Thorpe *vs.* the R. & S. R. R. Co., 27 Vermont, 149.)

In 1867 letters patent were issued to one De Witt for a discovery in the manufacture of a quality of oil known as aurora oil, and one Patterson became the assignee of the right conferred upon De Witt by his letters patent. Under a system of inspection provided by the laws of Kentucky, some casks of this aurora oil were branded "unsafe for illuminating purposes," and notwithstanding a statute of that State making it a penal offence to sell oil thus branded, Patterson sold the casks of oil in question to one Davis. Patterson thereupon was indicted, tried and convicted in one of the Kentucky courts for the alleged unlawful sale of the condemned casks of oil. This judgment convicting Patterson of a criminal offence having been affirmed by the Court of Appeals of that State, the cause was taken to the Supreme Court of the United States to test the validity of the statute under which Patterson was so convicted as a restraint upon the sale of a commodity covered by letters patent from the United States. Upon a review of all the questions involved, the validity of the statute was maintained, and the judgment of the Court of Appeals was in all things affirmed. The court held, in that case, and as we have no doubt correctly, that all the letters patent secured was the exclusive right in the discovery, and that the right thus secured was an incorporeal right, and hence without tangible substance; that the right to sell the oil was not derived from the letters patent, but existed, and could have been exercised before the issuing of such letters, unless prohibited by some local statute; that

because the patentee acquired a monopoly in his discovery, and was hence secure against interference, it did not follow that the tangible property, which came into existence by the application of the discovery, was beyond the control of State legislation; that, on the contrary, the right of property in the physical substance, which is the fruit of the discovery, is altogether distinct from the discovery itself, just as the property in the instruments or plate by which copies of a map are multiplied is distinct from the copyright itself; that hence the right conferred upon the patentee and his assignees to make use of and vend the corporeal article or commodity, brought into existence by the application of the patented discovery, must be exercised in subordination to the police or local regulations established by the State. The doctrine of that case was approved and followed in the recent case of Webber vs. Virginia (103 United States, 344), and has the support, either in direct terms or in principle, of numerous other carefully considered cases.

While, therefore, it is true that letters patent confer upon the patentee a monopoly to the extent of vesting in him, his heirs and assigns, the exclusive right to make, use, and vend the tangible property brought into existence by a practical application of the discovery ordered by letters patent for a limited time, it is not true that such right authorizes the making, using, or vending such tangible property in a manner which would be unlawful except for such letters patent, and independently of the State Legislature and State control.

The court then decides that the telephone has become a common carrier in the sense in which the telegraph is a common carrier, and all the instruments and appliances used by a telephone company in the prosecution of its business are consequently in legal contemplation devoted to a public use; and it is now a well settled legal proposition that property thus devoted to a public use becomes a legitimate subject of legislative regulation and control. This State regulation and control of property devoted to a public use is not the taking of property for a public purpose within the meaning of Section 66, Article I., of the Constitution of this State, nor is such regulation and control an interference with the guaranteed rights of the citizens in private property. The obvious deducion from what has been said, as well as from the authorities cited, is that the power of a State Legislature to prescribe the maximum charges which a telephone company may make for services rendered, facilities afforded, or articles of property furnished for use in its business is complete. The court then decides that the word "telephone" in the law means all the appliances needed to make the service complete, and rules against the company upon every point presented.

The opinion of the court seriously affects those most directly interested. They did not expect such a decision, and the local representatives of the American Bell Company, as well as their attorneys, who are the leading corporation lawyers of the State, do not know what will be their future policy until they read the decision in full and digest its full scope and bearing. The attorneys say they have, of course, no suggestions to offer. The expectation of the public was, and the intention of the telephone company was so expressed at the time of the beginning of the litigation, that the case would be carried to the Supreme Court of the United States for final adjudication; but in the interim the parent company has been plunged into a contest with the United States to defend the life of the patent itself, and it doubtless does not desire to have its energies wasted in any little side issues pending the settlement of the proceedings instituted by order of Secretary Lamar.

Under the terms of the arrangement made with subscribers last summer, when the war over the law was raging, the company obligated itself, in case such a decision as that above was rendered, to refund to subscribers the excess over the rate fixed in the bill, viz., $3 per month. This will require the outlay on the part of the company of about $15,000. The decision is variously commented upon by the people. There are those who regard it as a righteous measure, and answer the company's complaint that it cannot afford to do business as at present conducted on the basis allowed by the law by the suggestion that the royalty of the American Bell Telephone be reduced to a decent figure, and then there will be no trouble. The majority of business men interviewed on the subject, however, express a doubt as to the expediency of such legislation. Indianapolis has had the best telephone service in the country, and at rates much lower than those charged in other cities. Save on the part of a very few there was no complaint on the score of price, and they fear that business will be greatly interfered with by the deterioration in service that must ensue.

The court themselves share this feeling that the law is not expedient or just, for in the concluding paragraph of their decision they say: "There is nothing in the act of the Legislature under review, or contained in any other statutory or common law regulation applicable to the subject to which our attention has been called, which requires a telephone company to construct a new line against its will, or to maintain an old line longer than it may feel, in the exercise of legitimate business discretion, inclined to do so. Besides, the power of the Legislature to pass the act in question being conceded, this court cannot it in judgment upon either the justice or the injustice of the enactment of such a law. If the law shall prove to be either unjust or inexpedient in its operation, whether upon persons or corporations, the appeal must be made to the Legislature and not to the courts."

A dispatch of Feb. 23 from Chicago says: Regarding the recent decision of the Indiana Supreme Court as to charges for telephone service, to consider which the directors of the Central Union Telephone Company held a meeting here yesterday, Vice-President Louderback, of that company, said to-day that the decision had fallen on them like a thunderclap, and it appeared as though they were in an almost helpless condition. He did not know what could or would be done. There were about 100 toll stations in Indiana which barely covered the royalty to be paid the Bell Company, to say nothing of other expenses. Secretary Chapman said the rates charged to residences throughout the State was $3 a month, while places of business were charged $4. The Indianapolis and Terre Haute exchanges were the only points at which they charged $5 a month, and that barely sustained the lines. He thought the company would have to quit business or continue at a loss until the injustice of the law could be shown in the Federal courts.

A dispatch from Chicago, received as we go to press, states that the Central Union Company issued on March 2 notice of its intention to practically stop operations in Indiana.

The New "Law" Battery.

Among the recent improvements established in the manufacture of the well-known "Law" battery are some

FIG. 1. PERSPECTIVE VIEW OF IMPROVED "LAW" BATTERY.

which add considerably to its efficiency and durability. In our illustrations, Fig. 1 represents the improved cell in perspective, Fig. 2 being a longitudinal section through the lid. In this new cell the corrugated carbons are fastened to a central block of carbon, which is wedge-shaped and fits into a corresponding opening in the lid. In this manner the carbons are prevented from falling, and as an

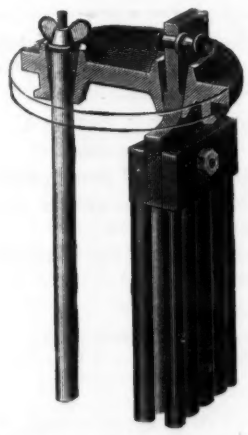


FIG. 2. LONGITUDINAL SECTION THROUGH LID.

additional safeguard the central piece is cemented to the lid, so that no movement is possible. Special care has been taken to make the corrugated carbons of uniform density throughout and of low resistance so that the action is a uniform one in cells coupled in series. It will be noticed also that the zinc passes through a long sleeve cast on the lid. This effectually prevents any motion and the possibility of its coming in contact with the carbon. In the old form of "Law" cell the neck outside of the glass jar was provided with lugs so as to constitute a lock for the lid. This has now been changed, the lugs being upon the lid and locking into the curved neck of the jar. In order to make the jar air-tight the outer edge is provided with a rubber washer, and the zinc also is similarly equipped where it enters the lid. The improved "Law" cell, which is made by the "Law" Telephone Company, of this city, seems to embody all the essentials of a remarkably serviceable open circuit battery. It has evidently had considerable thought bestowed upon it with the keenest perception of the end to be attained.

How to Wind the Magnets for Shunt, Series and Compound Machines—III.

BY CARL HERING.

[*Shunt Machines, Continued.*]

To determine directly what the current and what the number of windings must be for the assumed thickness c of a coil, calculate the diameter of the naked wire from the formula, take the gauge number wire nearest to it and measure its diameter with the insulation, which is best done by winding closely ten turns around a pencil or bolt, and measure the length of this little coil in inches; this multiplied by 100 gives the diameter of the covered wire in mils. Call this d_1. If the length of the core, or the space allowed for one magnet coil, be represented by e in inches, and the number of magnets on the machine by n, then it is evident that the number of turns per layer for one magnet will be

$$\frac{1{,}000\ e}{d_1}$$

while the number of layers will be

$$\frac{1{,}000\ c}{d_1}$$

and the number of turns per magnet $\frac{W}{n}$ will be their product,

$$\frac{W}{n} = 1{,}000{,}000\ \frac{e\,c}{d_1^2}$$

thus enabling one to calculate W directly, and consequently to determine a from $(a\ W)$

$$a = \frac{(a\ W)}{W}$$

If this current a is found to be very small, it might be more advantageous to use a greater current and less turns, and therefore less thickness, in that way decreasing the cost of the magnet wire, it being no small portion of the cost of the material of the machine.

If for a large machine the current turns out to be much smaller than 1.5 to 2.5 per cent of the whole current, it shows that the machine has not the most economical proportions, and that the same frame may be used, in case of incandescent light machines, with an armature having thicker wire and less turns, and therefore capable of supplying more lamps. Or in case of arc light machines, the same frame and armature may be used to give a higher potential at the same speed, thus supplying more lamps.

After finding what a is, it is advisable to calculate what current per square mil this will give with the determined diameter d, in order to guard against heating. In large magnets it should not be more than .0013 ampères per square mil. If it is found to give a greater value than this it is safest either to take a smaller current and more turns, or to increase the diameter slightly. In many cases it will be found that the diameter obtained from the formula—in which it depends on the allowable resistance—will be larger than that which would be obtained if it were calculated not to heat too much; but it is always safest to calculate both and take the largest.

If the current is found to be a large proportion of the total current, or if for the calculated diameter it is found that it will heat much, then the machine is overworked and ought to be used for doing less work, either by using the same armature and requiring the machine to give less electromotive force, or it may give the same electromotive force and less current, by taking a different armature with more turns of wire in it.

Owing to the fact that in most cases some insulating material, such as card-board or thick paper, is placed between some of the layers to insure an evenness in the winding, the real thickness of the coil will be thicker than that assumed in the calculation, and, therefore, the mean length and resistance will be slightly different, but this error is covered by the factor of safety of 20 per cent. in the allowable resistance.

For the sake of appearances the last or outside layer is always wound full, thus limiting the number of windings to certain successive numbers which are multiples of the windings in one layer. In general, however, if the number of turns be increased a little, the resistance will thereby increase, and, therefore, the current decreased, but the product of the current into the number of turns will remain approximately the same.

If after the magnets are finally wound and the finished machine tested, it is found that owing to some slight error it gives a slightly lower or higher potential, the speed may be varied slightly to make up for this.

Having made all the calculations for the magnets of the finished machine, it is best to check them finally by calculating the resistance from the following formula:

$$R = 50.13\ \frac{W\,l_m\,\delta}{d^2},$$

or if as before δ is taken 0.0162, and the temperature is assumed to be 70° F.

$$R = .875\ \frac{W\,l_m}{d^2} = \frac{3.5\ W\,l_m}{4d^2},$$

in which d is in mils, and l_m is the corrected mean length in inches, of a winding

From Ohm's law

$$R_1 = \frac{V}{a},$$

in which R_1 is the total resistance of the shunt circuit, in

cluding the adjustable resistance. The amount which this adjustable resistance may be, is evidently

$$R_1 - R.$$

If this turns out to be a negative quantity, that is, if R s greater than R_1, there has evidently been a mistake made in some of the previous calculations.

If the calculated value of R is found to be too great, owing to the fact that the gauge number of wire taken wasa little smaller than the value given by the formula, then it is quite safe to take the next size larger and keep about the same ampère windings, or else to modify the ampère windings accordingly, and then calculate R again as a check. It is quite safe to take a slightly larger diameter of wire for the same number of windings without any fear of increasing the resistance, for, from the formula of R, it will be seen that it increases only slightly, with an increased value for l_m, but decreases much more rapidly for a larger value of d.

If it is desired to regulate the machine for supplying the same potential to less lamps, by adjusting the resistance included in the shunt circuit, it is evident that it is only necessary to increase this resistance the proper amount, which can be done after the machine is finished, as it will change nothing in the preceding calculations.

If the machine is for arc lights in series, and it is desired to regulate it to supply less lamps, it will be necessary to make the test for both the maximum and minimum number of lamps and then make the resistance of the wire so low that in either case it is not too high to take its proper current, as required by its ampère-windings for that particular potential.

The total length of the wire, in feet, for all the magnets will be

$$L = \frac{W l_m}{12} = .0833\ W l_m.$$

To illustrate the calculation of shunt magnets by the above described method, let us assume that a certain machine with a given cylindrical armature and a frame with four cast-iron oval magnets, was required to supply 100 lamps of .7 ampères each, that is, 70 ampères, of 100 volts. The speed is to be 1,200 revolutions.

Upon running the machine with four temporary magnet coils of 250 turns each, it was found to require an exciting current of 40 ampères to make the armature deliver 70 + 2.5 per cent. of 70 = about 72 ampères at 100 volts. This gives $250 \times 4 \times 40 = 40{,}000$ (a W), as a measure of the magnetism.

The dimensions of the oval cross section were 9 inches by 3 inches. In order to determine the mean length of a winding, assume temporarily a maximum thickness of coil, one-third of 3, or 1 inch. The periphery of the core was measured and found to be 20 inches. This gives a mean length of one winding,

$$l_m = l + \frac{2\ c\ l}{a+b} = 23.3 \text{ inches;}$$

therefore from the formula

$$d = \sqrt{.875 \frac{(a\ W)\ l_m}{V}}$$

assuming a factor of safety of 20 per cent. that is taking V equal to 80 volts instead of 100, the value of d is

$$d = 102 \text{ mils,}$$

which is approximately equal to No. 10 wire.

Suppose this has an outside diameter of 125 mils. From the formula given above, the length of the core being 10 inches, there will be 80 windings per layer on each magnet, and 8 layers and therefore, $640 \times 4 = 2560$ windings in all. This gives $\frac{40000}{2560} = 15.6$ ampères in the windings. This very large current, which is 22 per cent., of the current in the external circuit, shows that the machine is very much overrated, and that it would not be economical, and even hardly possible, to finish the machine for 100 lamps. The heating would also be too much, for 15.6 ampères in a number 10 wire is .0019 ampères per square mil, which is too great. Furthermore the core is more than saturated, for its area of cross section is about 21 square inches, which gives for 10,000 (a W) per magnet, 475 (a W) per square inch, which as compared with the constant 240 is far too great. Suppose the curve of magnetization was found by the test to be $a\ d$ in Fig. 1. [*See* p. 21, Jan. 16.] It will be seen from it, that at 40,000 a W the magnets are very much over saturated. This curve would have been sufficient in practice, without the above calculation to show that the machine was overrated, but for the sake of illustration here, the calculations were also made.

From these figures, and from what was said above, it will be seen that the magnets would have to be altered in order to use the machine with this armature. As they are over saturated, they will have to be given a larger cross-section. For a proper percentage of current for the magnets, the large number of windings would make the thickness c of the coil much larger than it ought to be, from which it follows that the new magnets must also be made longer. In other words, these magnets have shown themselves to be much too small for that armature, or the armature has too few windings for the magnets.

The same machine was then run with another armature, which had more turns of thinner wire, the size of the wire being such as to stand a current for 70 lamps. Another armature might have been made with the same thickness of wire, but with more layers, thus supplying about the same number of lamps: but this increases the per cent. of loss of energy in the armature, it increases the lead of the brushes, increases the self induction and the sparking, etc., an is, therefore, not advisable.

Suppose the test with the new armature gave 18,000 (a W). Then the following values would be obtained directly from the formulæ:

d = 67.8 mils. = about No. 14.
(d_1 = about 88 mils.)
$W = 110 \times 11 \times 4 = 4840.$
a = 3.7 ampères.

The density of current in the wire would be .00115 ampères per square mil, and therefore, as compared with our constant C013, it is safe against heating too much. The density of magnetism in the cores would be 214 ampère windings per square inch, and therefore inside of the limit. The curve of magnetism, which will naturally be the same as before (except that it has a different scale for the abscissas or volts, which does not affect the saturation), shows that for 18,000 (a W) the magnets are not quite saturated.

The resistance will be

$$R = .875 \frac{W l_m}{d^2} = 24 \text{ ohms,}$$

giving an adjustable resistance of

$$\frac{V}{a} - R = 27 - 24 = 3 \text{ ohms.}$$

The reason why this is so small is because the resistance of the coil is greater, being 24 ohms, which is due to the fact that we selected the smaller size wire, No. 14, which is 64.08 mils diameter, as that is the nearest to the calculated value of d, 67.8. If we take the next size larger to 67.8 mils, that is, No. 13, the resistance would be much less, but at the same time the current a would be greater, as there would then be less turns for the same allowable thickness of coil.

If this adjustable resistance of 3 ohms is thought to be too small to admit of the proper regulation or adjustment, the speed may be increased a little, or the next size larger wire, No. 13, might be taken.

As the density of magnetism in the core is shown to be 214 (a W) per square inch, it will be seen that in a second machine of the same type the cross-section of the magnet cores may be decreased, thereby diminishing l_m, which decreases d; which in turn increases R and decreases a; thus diminishing the cost of the wire and the cost of the energy to supply the magnets.

The cross section of the magnets may be decreased to such an extent as to bring the density of magnetism up to the saturation point, as given by the curve.

The constant 214 also shows that the same machine may be run at a less speed, or it may be used to give a higher potential, or the same frame may be used with an armature having a few turns less and slightly thicker wire, thus supplying more lamps.

As the density of the current in the wire is below .0013, the first cost of the machine may be diminished at the expense of the efficiency, by taking more current in the magnets and less windings, and therefore less wire.

By a similar course of reasoning, it will often be found, from the results of such a test and the deductions made from it, that certain improvements can be advantageously made in the machine.

[TO BE CONTINUED.]

Application of Electricity to Propulsion of Elevated Railroads.*

BY FRANK J. SPRAGUE.

(*Continued.*)

As stated, this diagram and description are based on a level between stations, and the grades entirely change it, but it suffices for illustration.

With the above assumption, the distances are as follows:

Average between stations	1,722 ft.
Divided nearly as follows:	
Getting up to a little over half speed	130 ft.
Thence to full speed—about	495 ft.
Full speed	808 ft.
Slowing to stop	289 ft.
The average speed in feet, per second, would be:	
Getting under way	19.7
Full speed	29.1
Slowing to stop	14.1
Mean between stations	21.3
The average speed in miles, per hour:	
Getting under way	13.4
Full speed	19.2
Slowing to stop	9.6
Mean between stations	14.7
Distance traveled while slowing to stop:	
At 20 stations	5,780 ft.
A 6 stations	1,734 ft.
Effective traction distances:	
Up track, 13,160 + 15,100 − 5,780 =	22,500 ft.
Down track, 16,510 + 151,600 − 5,780 =	25,830 ft.
The official weights, in pounds, are:	
Empty car	23,850
50 passengers at 130 lbs	11,180
Motive power per car (electrical)	4,950
Total of loaded car	39,980
Weight in net tons:	
Loaded car	20
Train of four cars	80

* A Paper read before the Society of Arts, Boston, Mass, Dec. 10, 1885.

Energy required in overcoming inertia alone in getting under way:

$$\frac{80 \times 2{,}000 \times (29.1)^2}{33{,}000 \times 64.4} = \text{63.8 h. p.}$$

To get the *capacity* of the engine we have the speed o trains accelerated one foot per second when running from say 15½ to 16½ feet per second.

The foot-pounds expended per second in overcoming inertia then would be:

$$\frac{80 \times 2{,}000 \times (16\frac{1}{2}^2 - 15\frac{1}{2}^2)}{64.4} = 79{,}488$$

The foot-pounds expended in traction for the same period would be:

$80 \times 8 \times 16 =$	10,240
The sum is	89,728

Hence the net motor capacity is:

$\frac{89728}{550} =$	163.1 h. p.
Plus 5 per cent. friction, gives a motor capacity, per train, of	171.3 h. p.
or forty-three horse-power per loaded car.	
Plus another 5 per cent. friction gives necessary *engine capacity* for 80-ton train of	179.2 h. p.

For any given grade and weight of train within the limit of speed considered the tractive strain is a constant.

For eighty tons on a 105-foot grade this tractive strain is 3,822 pounds.

A net motor capacity of 163.1 horse-power, developing 89,728 foot-pounds of effective work, is then sufficient to pull an 80-ton train up a 105-foot grade at the rate of $\frac{89728}{5822} = 23.5$ feet per second, or 16 miles per hour.

Total energy per single trip in overcoming inertia in 33,000 ft. lb. units:

26 × 63.8 plus 5 per cent. friction	1,742 units.
Or per round trip	3,484 "
Energy of lifting, up trip:	
$\frac{80 \times 2000 \times 144.42}{33000} =$	700 "
Plus 5 per cent. friction	735 "
Energy of falling, down trip	700 "
Energy of lifting, down trip:	
$\frac{80 \times 2000 \times 137.6}{33000} =$	667 "
Plus 5 per cent. friction	700 "
Energy of falling, up trip	667 "
Total work of lifting the train on round trip, 735 + 700	1,435 "

Since momentum of train is more than sufficient for traction on down grades and while slowing to stop, work of traction is only debited to motor on level and up-grades, less the space traveled over in bringing train to rest.

Up to the speed attained, and with the excellent rolling stock used, the traction may be taken as 8 pounds per net ton.

The *energy of traction* thus expended would be:

Up trip:	
$\frac{80 \times 8 \times 22500}{33000} =$	436 units.
Plus 5 per cent. friction	458 "
Down trip:	
$\frac{80 \times 8 \times 25830}{33000} =$	501 "
Plus 5 per cent. friction	526 "
Total work of traction, 458 + 526	984 "

Résumé of work expended during one round trip:

Starting, up track	1,742 units.
Starting, down track	1,742 "
Lifting, up track	735 "
Lifting, down track	700 "
Traction, up track	458 "
Traction, down track	526 "
Total	5,903 "

or briefly,

Starting	3,484 units,	or 59.0 per cent.
Lifting	1,435 "	or 24.3 per cent.
Traction	934 "	or 16.7 per cent.
	5,903 "	100 per cent.

Average per minute for round trip $= \frac{5903}{84} = 70.3$ h. p.

Average per minute running time $= \frac{97}{80} \times 70.3 = 85.2$ h. p.

At the busiest time there are 63 trains in operation, whence we have for the total power developed in motors at one time—

$$63 \times 70.3 = 4{,}429 \text{ h. p.}$$

These determinations have been made to include 5 per cent. friction for electric motors. For locomotives, friction is counted as 10 per cent.

This would give a total of 4,640 h p. for the steam plant.

With present steam plant, one engine—

Makes, round trips	9
Uses, lbs. of coal	5,760
Is on duty, hours	20
Uses steam, hours	6
Average consumption per trip, lbs	640

We have

Total horse-power per round trip		6,184
Horse-power per pound of coal	$\frac{6184}{640} =$	9.66
Pounds of coal per horse-power per hour	$\frac{60}{9.66} =$	6.21

I have neglected the amount of steam used in braking, also the slowing down and speeding up again when following close to other trains, and the losses while standing

still both from radiation and escaping steam. These items will reduce the coal expenditure to less than 6 lbs. Since it costs about $4 per gross ton to put the coal on the engines, and they use 640 lbs. per round trip, it will be seen that the coal expense is only about $1.15 per round trip, including waiting time, an average of 2½ cents per station. One additional passenger at every other station during commission hours, or one every fourth station at other hours would pay the coal expenses of the trip. From this it will be seen how important it is to increase the carrying capacity, whether with or without an increase of coal expended.

In a steam plant an 80-ton train has the weight distributed as follows:

Locomotive, 22½ tons..	45,000 lbs.
4 cars at 23,850 lbs.	95,400 lbs.
151 passengers, at 130 lbs.	19,630 lbs.
	160,030 lbs.

The 80-ton electrical train has weights distributed as follows:

Motive power, 4 × 4,950 =	19,800 lbs.
4 cars at 23,850 lbs.	95,400 lbs.
344 passengers at 130 lbs.	44,720 lbs.
	159,920 lbs.

The electrical train of this gross weight will carry double the number of passengers. If the steam train should carry the same number of passengers, 344, that an 80-ton electrical train will carry, its weight would be:

160,030 + (193 × 130) = ... 185,120 lbs.
Or nearly ..... 92.6 tons.

During commission hours the weight of electrical train per passenger is $\frac{159920}{344} = 465$ lbs. The excess of weight of a steam train over an electrical train when carrying 344 passengers is 25,200 lbs. This distributed in an electrical train gives an additional passenger capacity during commission hours for the same gross weight moved of—

$$\frac{25200}{465} = 55 \text{ passengers per steam train.}$$

For 63 trains, four cars each, there would be $54 \times 63 = 3{,}402$ through passengers—or double that number of way passengers—at one time.

A steam locomotive of the type considered has 30,000 lbs. weight on the drivers, hence its tractive weight is 15 tons.

An electrical train having the motive power distributed has an effective tractive weight of 80 tons, or 20 tons per car.

In an electrical system such as I have devised, a large proportion of the energy of the trains is recovered when slowing to stop and on down grades. This is accomplished by a method of braking which consists of being able at will to convert the energy of the moving train into electrical energy and deliver it to the line, and by the same apparatus which controls the speed and power of the train. On a double track road the energy given to one track may be communicated to the other as well as along itself. The up grades of one track being balanced by the down grades on the other track, it is evident that the total up grade of a system is equal to the down grade thereof. Therefore, energy being expended in getting under way and climbing up grades, and a large proportion of this being given back in stopping and running on down grades, it is evident that the energy required in the system is that necessary to move the trains continuously on level grades, with a percentage for loss in conversion and reconversion added.

This is one of the very great advantages of an electric railroad where grades and stoppages are frequent, and a large number of trains is operated.

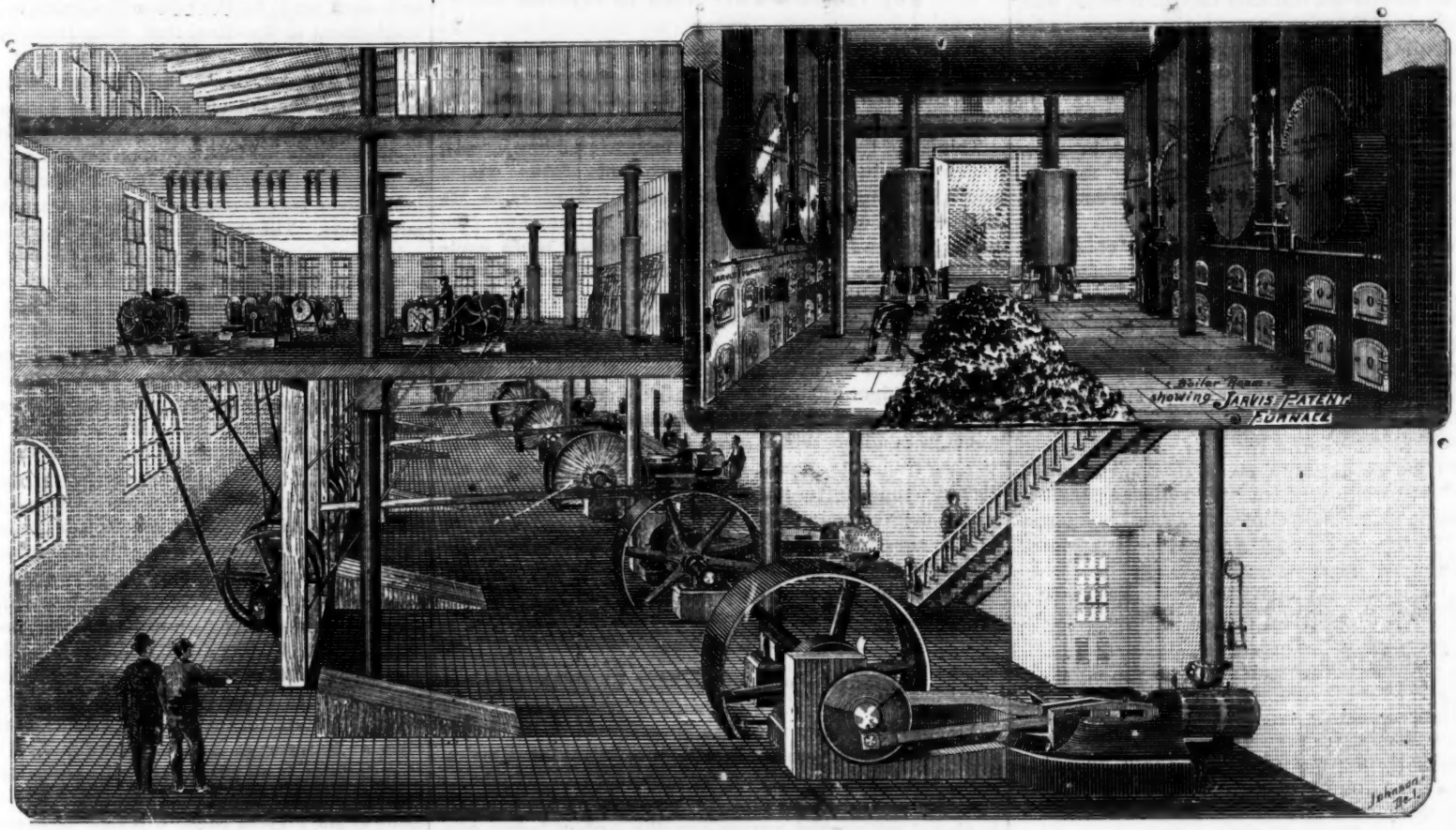
(TO BE CONTINUED.)

The Edison Light in Chili.

It is not generally known that the Edison incandescent light made its appearance in the far-away Republic of Chili almost simultaneously with its commercial advent in the United States. An Edison dynamo serving 60 lamps of 16 candles was installed in the Teatro de Variedades, Santiago, in the fall of 1881, and probably the first dramatic performances ever illuminated by incandescent light were given at that time. At present a central station, serving about 2,500 lamps, is in operation in the city, and many mills, factories and private houses in other parts of the country are successfully using isolated installations. Among these is the palatial residence of Señora Cousiño, which has been illuminated by 300 lamps for the last three years, the current being generated by four dynamos, while the fixtures used are of the most expensive class.

An Edison station serving 500 lights is also located in a small town close to the Indian frontier, and the curious spectacle of modern American machinery in operation in a place where the population is still semi-savage, may be seen nightly.

The Valparaiso house of the firm of W. R. Grace & Co., of this city, are the Chilian agents of the Edison Company, who possess exclusive patents in the land of the Southern Cross, and who are about, it appears, to be given another opportunity in lighting up Valparaiso itself.



VIEW OF THE NEW BRUSH STATION, BOSTON.

New Brush Station at Boston.

It is now five years since the first Brush arc light station was started in Boston, on Lancaster street, and although its capacity has been steadily increased, it has been deemed advisable to add another station. The latter, recently finished, is situated on Ferdinand street near the Boston and Providence Railroad depot. Our illustration shows a section of the building exposing the engine room and the dynamo room above it, together with a perspective of the boiler room. As will be seen, there are five Armington & Sims' engines, 16½ x 24, employed in driving the dynamos. Steam is generated by seven boilers, which, together with all the rest of the motive power installation were furnished by the Jarvis Engineering Co. Altogether the station is one of the finest in New England, and will no doubt show higher economy with increased profit with all the improvements which it embodies. The illustration is far from doing it justice.

Petitioning against Capital Stock Taxation.

The Western Union Telegraph Company has sent a petition to the Legislature, asking that it be relieved from the judgment requiring it to pay a tax on its capital stock for 1881. It says the judgment requires the company to pay to the State of New York a tax on its entire capital stock, while only a small portion of its capital is employed or situated in New York State, and it pays heavy taxes to other States on its property situated therein. The last Legislature acknowledged that assessing the entire capital stock of the company was wrong, and amended the law of 1881 so as to assess only so much of the capital stock as is represented by property within the State for 1882, 1883 and 1884 and thereafter. The company claims that the tax is equally wrong for 1881. The company, therefore, asks that a general law be enacted correcting this legal wrong and remonstrates against any extraordinary coercive legislation until the company can be heard by counsel before the proper committees of the Legislature.

The Amherst Water Motor.

The Amherst Hydraulic Motor Company, which has been equipping its works at Holyoke, Mass., and perfecting the motor, is now hard at work supplying the rapidly increasing demand for the motors. It is unable to keep up with its orders at present. The following letter from the Superintendent of Water-Works in Lake View, Ill., is a fair testimonial of the merits of the motor:

RAVINSWOOD, Ill., Feb. 12.

Amherst Hydraulic Motor Co.

GENTLEMEN: We are very much pleased with the new No. 1 water motor you sent us, to be used to propel an electrical generator and other machinery for a telephone exchange, and we are surprised at the amount of its power with the small amount of water used. The ordinary domestic pressure of our water-works is from 35 to 40 pounds, which is amply sufficient to run the motor and generator at a very high rate of speed, in fact we do not use to exceed one-fourth of the amount of water supplied through a three fourths inch lead pipe. We find it is always ready to start from any position, can be run very rapidly or very slowly. What surprises us most is that the power seems to be the same in either case, and consequently we do not need to run it rapidly for generating a steady and strong electric current. In short it is all and more than your circular says of it, and I think you yourselves would be surprised to see what it will do in this somewhat new use to put it to. I inclose you draft on Boston, being payment of bill for same.

Yours truly, A. S. GURNEE,
Superintendent of Water-Works, Lake View, Ill.

Electricity for Street Railways.

The fourth annual Convention of the American Street Railway Association was recently held at St. Louis. The following is an extract from the report of the committee upon the utilization of electricity for motive purposes: "Your committee considers the application of electricity to the propulsion of street cars as entirely feasible. The seven electric railways in Europe, besides the tests in this country, prove this to be true. It is now narrowed down simply to a question of dollars and cents, or comparative economy with horses, cable power, etc. In the crowded streets of American cities no system of overhead wires would be permitted by the municipal authorities. The rails could not be used to carry the currents, for obvious reasons; therefore a conduit system offers the only practical solution. The system of running cars by accumulators can be applied with least trouble and less first cost, but at a great sacrifice of electricity. The result of two years' working of the electric railway at Zankerode, Prussia, showed that only 30 per cent. of the power of the steam engine was applicable to the propulsion of cars, but even this compares favorably with the cable system." In conclusion, a letter was read from a New York firm offering to equip any tramway with electric motors, and to stipulate that should satisfaction not be given the parties contracting would move the same at the company's own cost,

The Self-Induction of an Electric Current in Relation to the Nature and Form of Its Conductor.

BY PROF. D. E. HUGHES, F. R. S.

(*Continued.*)

INDUCTIVE CAPACITY OF METALS.

The results of the following experiments prove that the force and duration of the extra-currents depend upon the kind of metal employed as a conductor, its molecular condition, and the form given to the conductor, independent of its resistance or the electromotive force of the primary current. The increase of force by increased length is proportional to the length of wire less its additional resistance, but with wires of the same length increased cross-section or diminished resistance does not produce a corresponding increase in the electromotive force of the extra-currents.

The time of charge and discharge of the wire is independent of the electromotive force of the extra-currents; for if we compare currents of equal electromotive force obtained from copper and iron, it will be found that the duration of these currents in wires of 1 mm. diameter will be seven times slower in iron than in copper, and a still greater difference will be found in larger wires. The longest or slowest charge and discharge take place in the purest soft iron, and have a constant ratio of increase with increased diameter of the wire; my experiments giving for wires of double the previous section, or for wires of four times less resistance, a mean increase of three times its previous duration.

The electromotive force of the extra-current in different metals will be seen in the following table, and in order that the values obtained from the sonometer may be clearly understood, I have reduced the results to comparative values.

The tables of values were obtained on wires of similar length, having been repeated on a similar series of lengths ranging from 10 cm. to 5 metres. The instrument is sufficiently sensitive for pieces only 10 cm. in length, and the results from the short lengths were as pronounced and accurate as those for greater lengths. I may add that the instrument shows no effects or traces of static charge for the lengths mentioned.

TABLE I.

WIRES 1 MM. IN DIAMETER, 30 CM. IN LENGTH.

Soft Swedish iron	100	Copper	20
Soft puddled iron	78	Brass	13
Swedish iron, not softened	55	Zinc*	12
Soft cast steel	41	Lead	10
Nickel*	34	German silver	7
Hardened cast steel	28	Mercury*	2
Cobalt*	24	Carbon*	1

* Being unable to procure wires of these metals, they were tested in the form of strips, and compared with similar strips of copper. Mercury was in a glass tube 2 mm. in diameter; carbon tested in the form of electric light carbon from 3 mm. to 10 mm.

The above table is only true for wires of 1 mm. diameter, as the effect depends on the size of the wire in relation to the nature of the metal. In soft Swedish iron a diminution in the electromotive force of the extra currents takes place with each increase in its section, and this has been partially foreseen by Maxwell,* who said: "The electromotive force arising from the induction of the current on itself is different in different parts of the section of the wire, being in general a function of the distance from the axis of the wire as well as time."

From this I expected that the increase of electromotive force by an increased section would not increase directly as its sectional increase; but I was not prepared to find, as my experiments prove, that after a certain maximum diameter of wire has been reached, a marked decrease in electromotive force takes place with each further sectional increase, and that this maximum is variable with each metal.

The diagram shows a rapid rise of force in soft iron from an extremely fine wire of 0.10mm. section to a maximum at 1 mm., from which point there is a slow but continued decrease of force with each increase in the size of the wire, until at the comparatively great diameter of wire of 10 mm. the force is but a fraction more than in the extremely fine wire.

Hard Swedish iron has a less initial force in the fine wire, and does not arrive at its maximum until the wire has 3 mm. diameter, being then nearly of the same force as soft iron of the same diameter; the fall from this point is somewhat similar, but less than soft iron until at 8 and 10 mm.; soft and hard iron have absolutely the same values.

A curious change of values at different diameters will be seen in copper and brass. Copper, having nearly double the initial force in fine wires, arrives at its maximum at 4 mm.; but brass creeps slowly up, passing copper at 5 mm., arriving at its maximum at 6 mm, and finally, in the large section, 10 mm., it has more force than copper, their positions being completely reversed.

I have been unable to obtain wires of different diameters of other metals; but zinc rods of 10 mm. gave a still higher rate than brass, while in small diameters its force was less. For non-magnetic metals it is probable that the greater the specific resistance of the metal, the greater will be the diameter of the wire before the fall commences.

* "Electricity and Magnetism," vol. ii., p. 291.

Carbon is remarkably free from self-induction, and although there is a rise of force in rods of 3 mm. to 10 mm., it is so small as to be hardly measurable. German silver rises with comparative rapidity, indicating that with wires of 20 mm. its force would equal that of copper.

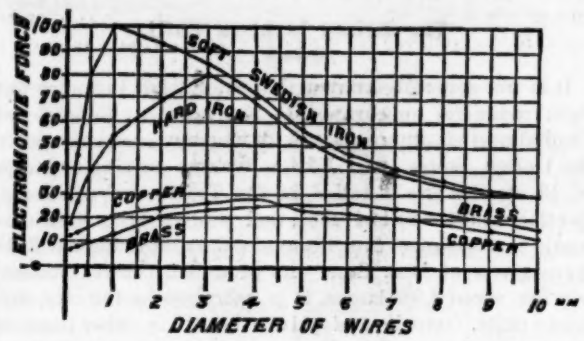


DIAGRAM OF RISE OF E. M. F. IN VARIOUS WIRES.

Carbon, therefore, seems peculiarly adapted as a resistance when used in the variable period of electric currents.

(TO BE CONTINUED.)

Why Telephones are Noisy in Fly-time.

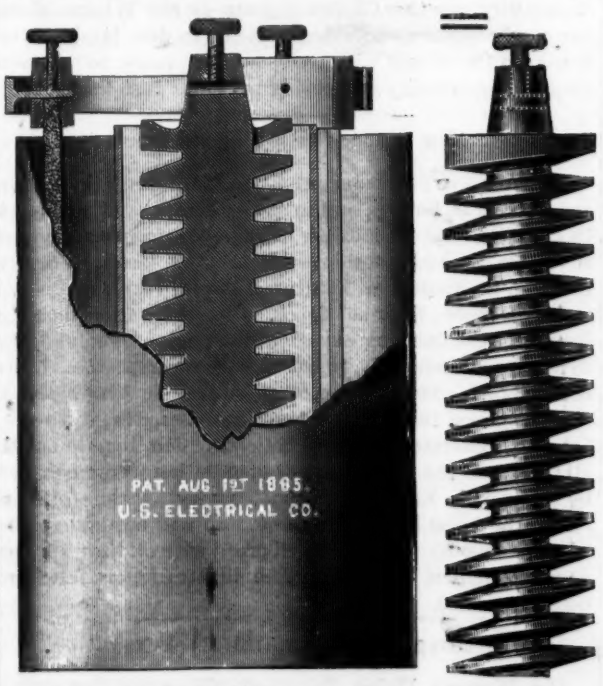
We are gravely informed that an English scientist has made the discovery that flies have a language of their own, inaudible to unaided ears, though, no doubt, distinctly audible to the ears of insects.

This is not the buzzing tone common to all flying insects, which is produced by the rapid movements of their wings, and is but a mere incidental effect, as meaningless as are the sounds of our footfalls while we are walking and conversing with a friend, but it consists of other tones made voluntarily, no doubt, for the purpose of limited communication with one another.

The discovery was made by means of the microphone, while magnifying the tramp of a fly walking on the table, till it sounds as loud as that of a horse passing over a wooden bridge. By close observation during these experiments other sounds were heard different from those of its footfalls or wings, which prove to be its trumpeting calls issuing from it proboscis, and resembling somewhat the distant whinnying of a horse. Such are some of the results of that marvelous instrument, which acts for the ear of man as the microscope does for the eye. Perhaps some of our telephone friends can now account for the noises that trouble them, and that have been the subject of much searching, but not altogether successful, investigation.

A Novel Form of Battery Element.

Among the recent novelties in galvanic batteries the Lathrop battery, shown in the accompanying illustrations, is of interest. As will be seen in Fig. 1, which is a sectional view of it, the zinc, contrary to the usual method, is placed *within* the porous cup, the carbon being contained in the outer jar. The most important feature of the battery, however, is the shape of the zinc, which, as shown in perspective in Fig. 2, is of screw form, thus presenting a large surface to the action of the acid. This peculiar form also enables the zincs to be self-amalgamating, as it were. This is accomplished by dropping a little mercury in the pocket of the zinc at the top. Passing down through the small hole, it follows the thread of the screw and, it is claimed, completely amalgamates the zinc, keeping it bright, and thus preventing local action. The battery, which is made in several forms and sizes by the United States Electrical Company, of this city, is said to give very good results when employed in running incandescent lamps and small motors.



FIGS. 1 AND 2.—NEW FORM OF ZINC ELEMENT.

Two Circuits from One Battery.

To the Editor of The Electrical World:

SIR: Will you kindly explain the following: Two lines, Nos. 1 and 2, take battery from same strip on switchboard at *A*. No. 1 takes battery at both ends (*A* and *B*), No. 2 only at one end (*A*). The solution in one of the cells of battery (at *A*) got down about one inch below the zinc. This showed cross on the lines named. Why does it not open both lines? ENQUIRER.

LOGANSPORT, Ind.

[ANSWER.—The circuit can only be completed through the two grounds at *B*, the battery being, as you say, open at *A*. But since No. 1 and No. 2 are connected together at *A*, the circuit is always closed through both now. Thus from battery at *B* over No. 1, back over No. 2 to ground and ground to battery again, there being two grounds at *B*. Hence, every time you close key over either one line, you send current over both, and thus have the effect of a cross, though not one in reality.—EDS. E. W.]

The Invention of the Incandescent Lamp.

To the Editor of The Electrical World:

SIR: In your last issue Mr. Richard N. Dyer, one of the Edison company's patent attorneys, puts forth a manifesto intended probably to assist your readers to accept the statement made by the Edison Company in their new advertisement to the effect that "the Incandescent Electric Lamp is the universally acknowledged invention of Thomas Alva Edison." These be brave words, but it is reported that the Edison stockholders have been recently assessed for the purpose of defending suits brought against their company for the unauthorized use of the incandescent lamp! The acknowledgment is scarcely *universal*.

Mr. Dyer travels over the well-worn track of the Edison supporters. The three elements are there again—the receiver entirely of glass, from which the air is exhausted, platinum wires sealed into the glass, and an incandescing carbon "filament" (there is some magic spell for an Edison man in the word "filament") within the globe, such filament being of "high" resistance. Mr. Dyer does not tell us what is "high" or "low;" the previous experimentalists, he says, failed because their carbons were of too low resistance. How "high" may a carbon be without infringing the "fundamental" patents of the Edison Company?

It would have been well if Mr. Dyer had stated whether he supported the claims of the Edison Company from the standpoint that Edison was the inventor of the incandescent lamp scientifically speaking, or within the meaning and for the purpose of the U. S. patent laws. He must surely mean the latter, but then unfortunately the Patent Office after a fight of five years has decided against him, and, not being able to revoke the "fundamental" patent already issued to Mr. Dyer's client, has issued a "fundamental" patent for the same invention to the representatives of Sawyer & Man. Of course Mr. Dyer may say that decision is all wrong (the defeated party generally does say that), but it is the only one that exists on the point at issue at the present time. If, as Mr. Dyer says, the Sawyer-Man lamp was not such "a practical and commercial success" as Edison's, possibly Messrs. Drexel, Morgan & Co. and the capitalists who put money into the one but not into the other project are to some extent to be credited with that. Perhaps they should be considered as joint inventors. A. T. Stewart made "a practical and commercial success," but he did not claim to be the "universally acknowledged" inventor of calico. There are plenty of valuable inventions that are not "a practical and commercial" success simply because they and capital have not been brought together.

A point to be remembered is that the decision of the Patent Office in the case referred to only related to the question of priority as between the parties. With reference to the three elements of the claims of the Edison Company, Mr. Dyer will probably not dispute the fact that they were all old and well known; but he will say, the combination of them all "substantially as and for the purposes described" involved invention, and was new. He has referred to experimentalists. If he will refer to *Philosophical Transactions* for 1876, Vol. 166, p. 351, he will see that an experimentalist used a receiver from which the air was exhausted and which was entirely of glass; this receiver had platinum wires passing through the glass to which they were directly sealed by fusion, and these wires conveyed current to an incandescing filament of platinum. If he will refer to *La Nature* for the 7th of December, 1878, he will find that M. Niaudet, in an article on the divisibility of the electric light, says that one of the principal inconveniences of metallic wires is that if the current is not regulated, melting of the wire occurs, and that the idea of employing carbon in place of metals appears to belong to King, and to date from 1845. Probably you do not care to try the validity of the Edison patents in your columns, but the two references given above seem remarkably pertinent, and they were not given by the Patent Office on Mr. Edison's applying for his "fundamental" patents. In fact, the office appears to have scarcely looked at the state of the art at all, for some reason or other. Mr. Dyer can, no doubt, give some explanation of the points briefly referred to in this imperfect communication, which I shall be glad to see supplemented by others of greater weight.

If the Edison Company or Mr. Dyer desire to discuss this question it will be interesting, if not profitable; but there is an impression abroad that the Edison Company will be wise to confine their claims to the many valuable improvements which do belong to them, and not lose what they have by trying to claim the whole earth. LUX.

WOBURN, Mass., Feb. 27.

The Franklin Institute Tests.

To the Editor of The Electrical World:

SIR: May we be permitted to add a few lines to the discussion now going on in your columns respecting the accuracy of the horse-power measurements made by the Committee of the Franklin Institute, when testing the Weston and Edison dynamos? We must in the first place disclaim any intention to champion the views of Mr. C. F. Heinrichs, who originated and who is responsible for this controversy, but we feel compelled to make a few comments upon the lengthy letter of Mr. George B. Prescott, Jr., which appeared in your issue of Jan. 30, in so far as it refers to ourselves.

Your correspondent professes to hold aloof from any criticism of the results obtained by us with the Heinrichs machine, but in the same breath he taxes us with having conducted our experiments with very crude instruments, and says that therefore our tests should not inspire more confidence than those conducted by the Franklin Institute.

He backs up his opinion by the statement that our Mr. Alabaster remarked in the Philadelphia Exhibition that in his (Mr. Alabaster's) opinion, the Ball unipolar dynamo was the best ever made. It is only necessary here to say that our colleague denies having expressed such an opinion to anybody while in America; this, however, is of but little moment, and is no argument. Assuming for the nonce that such an expression was evoked, that would not lower the efficiency of the Heinrichs machine. If he had gone further and said that Mr. Geo. B. Prescott, Jr., was, in his opinion, the greatest electrician in the States, the achievements of Mr. Edison would not thereby possess less value.

But we have no wish to indulge in personalities, a mode of argument in which we will readily yield the palm to those who fancy such allusions can give force to the views they are pleased to hold. We desire, however, to deny *in toto* that our measurements were conducted with crude instruments; the several apparatus at our command were named in our report, and the final selection of an Ayrton and Perry voltmeter would not, in our opinion, even at the present day, be held to be injudicious. Unfortunately for Mr. Prescott his opinion has not the value which might otherwise be attached thereto, even by those who know him, for his excessive volubility makes him forgetful of prior utterances. In the January or December number of the *Electrician and Electrical Engineer* there appeared an article from the pen of this gentleman himself, dealing with these very instruments. He admits that they are in extensive use, and that when selected according to certain specifications, when calibrated as often as once a fortnight to once in three months (a wide limit), and then handled with judgment, they may be made to yield results sufficiently reliable for most commercial work. We have no reasonable doubt that the instrument employed by us was selected after due consideration and handled with judgment; it was calibrated about three times a fortnight by Mr. H. R. Kempe, whose name may be a sufficient guarantee, even for Mr. Prescott himself, as to the accuracy of the method adopted. Independently of this there was (as stated in our report) such a close agreement between the calculated results of electromotive force, current, and resistance, and the indications observed, that we were perfectly satisfied our electrical instruments were reliable, and that every dependence might be therein placed.

The well-known English journal *Engineering*, in two long and exhaustive articles on our tests, says: "This investigation has been conducted with great care and completeness." * * * "We believe that the following description of the tests will be found valuable as trustworthy examples of the methods in which trials of dynamo electric machines should be conducted." * * * "From the above description it will be seen that throughout this investigation the greatest precautions were taken in order to obtain accurate results," * * * "the last tests, marked with an asterisk, were taken by Mr. Heinrichs' staff in the presence of Mr. W. H. Preece, F. R. S. Mr. Preece supervised the operation, and expressed his satisfaction with the manner in which the tests were conducted." These last tests were conducted in a precisely similar manner to the previous ones and verified exactly the results obtained by us. Enough, we think, has now been said so far as we are personally concerned; had we occasion to test other dynamos of a like nature to that of Mr. Heinrichs, we should not desire better instruments for the purpose.

In conclusion we may add that to the best of our knowledge not a single objection has hitherto been raised by engineers in this country on any one point connected with our report on the Heinrichs machine. Full particulars of these tests, with illustrations of all the apparatus employed, can be found in *Engineering* of May 2 and 16, 1884. H. ALABASTER, GATEHOUSE & CO.

LONDON, Feb. 11, 1886.

A New Medical Battery.

The many valuable properties of the chloride of silver battery have led Mr. John A. Barrett, of this city, to devise an arrangement by which that battery could be made available for the use of physicians. The latter desire to be relieved as much as possible from the care of

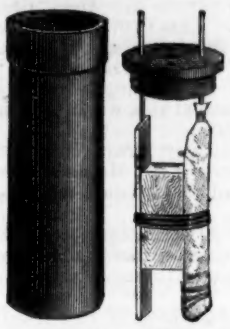


FIG. 1.—CONSTITUENT PARTS OF CELL.

batteries in electro-medical work, and the chloride of silver cell meets the requirements very well. While the cell is generally termed an open-circuit battery and consumes no material on open circuit, it can, nevertheless, be used continuously for many hours without polarizing,

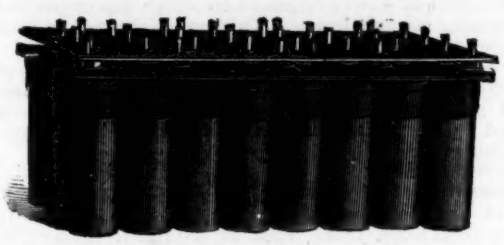


FIG. 2.—BATTERY READY FOR WORK.

which may in some instances prove of value to the physician.

Our illustration, Fig. 1, shows the constituent parts of the cells, and Fig. 2 represents them as they are joined together for actual work.

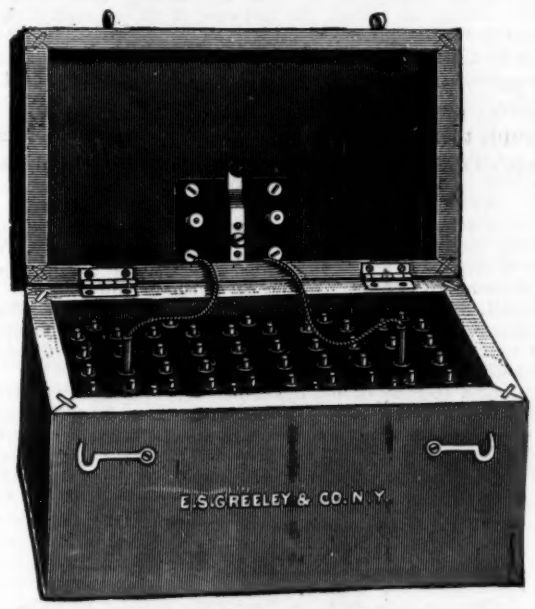


FIG. 3.—BATTERY IN BOX.

The jars which hold the fluid and inclose the elements are of hard rubber, three inches long and one inch in diameter. The plate of hard rubber has upon its upper surface rows of projecting studs, corresponding to the number of cells of the battery. To the under side of this plate

FIG. 4.—MILLIAMPEREMETER.

are permanently attached plugs or stoppers of hard rubber, which form the caps of the battery cells. These plugs and the mouths of the bottles are provided with corresponding threads, so that each bottle may be readily screwed to its cap, or removed from it, without interfering with the others. The metallic elements of the battery are zinc and chloride of silver, connected in order to the studs forming the terminals of the successive cells, by silver wires, which pass up through perforations in the caps and plate, and are screwed down in pairs under nuts turning upon the studs. A perforated top plate of polished rubber, through which the tips of the studs project, is laid over the whole. On this plate are stamped the number of the studs in the order in which the connections of the battery are made. The current reverser is contained in the cover of the box (Fig. 3), and to this are attached two silk-covered conducting cords, terminating in hollow plugs which fit over the tips of the studs. By means of these cords and plugs any number of cells may be selected from the battery. The current reverser is also provided with two split binding posts for attaching the cords which conduct to the electrodes. Our illustration (Fig. 4) also shows a milliampèremeter designed by Mr. Barrett, which reads up to .50 M. A. We may add that Messrs. E. S. Greeley & Co., of this city, have undertaken the manufacture of this battery.

Explaining How the Recent Telephonic Litigation Began.

A dispatch of late date from New Orleans says:

Mr. Watson Van Benthuysen, President of the National Improved Telephone Company, in an interview published in the *Times-Democrat*, shows the connection of his company with the telephone litigation now before the country. Mr. Van Benthuysen says that in some unaccountable manner the Pan-Electric Company has been placed before the public as the principal litigant in the case, when, as a matter of fact, his company originated the suit at Memphis and carried the matter before Secretary Lamar at Washington. The Pan-Electric Light Company had nothing to do with it, as the record will show. Mr. Van Benthuysen says that he and three other stockholders in the National Company applied on July 12, 1885, to Mr. Garland to order a suit to be brought against the Bell Company on the ground that its patent was obtained by fraud, and as a consequence was void. Mr. Garland refused to have anything to do with the matter, and turned the letter over to the Interior Department.

When the second petition was made to the District Attorney at Memphis, and thence to the Department of Justice there was not a single person signing the petition that had any interest in the Pan-Electric Telephone Company, and the impression on Mr. Garland's mind that the petition was from the Pan-Electric Company must have arisen from the fact that Colonel Casey Young introduced them at the second interview. Attorney-General Garland at no time had any connection with or interest in the National Improved Telephone Company.

"Electrician Rogers" and the Pan-Electric.

With regard to the electrical originator of the Pan-Electric scheme, the following comes from Washington:

The Pan-Electric Telephone people are central figures here just now. Rogers, who invented the telephone, was formerly electrician of the House, having charge of the lighting apparatus and what little electric apparatus there is in connection with the machinery of that end of the Capitol building. The house is lighted mostly by a network of gas pipes and jets above the stained ceiling of the hall. They are ignited by electricity, and the person who has charge of them, who sees that they are burning properly and kept in order and who goes about in the halls and corridors of the Capitol turning on the gas and lighting it with a wax taper, is called by courtesy the "electrician" of the House, simply because some of the lights are lighted by electricity. By right he ought to be called the lamplighter, but that would not sound so large, and so he is called the "electrician." That was the position which Rogers held when he offered the Pan-Electric Telephone to the "tenderfoots" of the House and Senate. A correspondent met, some time ago, an old and thorough electrician, who has seen every stage of the telegraph and telephone, and asked him if he knew anything about the Pan-Electric.

"I know all about it," he said. "Set down the figures 745. Now multiply that by 12. Now divide the product by 10. Now multiply it by 6 again. Now add 84. Now subtract 5448 from it and what have you left?"

"Nothing."

"Exactly; well that is just what the Pan Electric Telephone Company amounts to. It was gotten up by this cranky fellow Rogers and was a cheap imitation of others. He went through the form of calling himself a company, issued stock and gave away millions of dollars worth of the imaginary stuff, entirely worthless, as I have always believed and still believe; gave it to whoever in official circles would accept, with the idea that their names and influence would help him to get something out of it. The brighter men of the House, such as Sam Cox and Abe Hewitt and lots of others refused the stuff." So much for Rogers, the inventor.

Ordering the Investigation.—The House of Representatives on Feb. 26 adopted the report of the Committee on Rules providing for an investigation of the Pan-Electric Telephone scandal by a special committee of nine. The committee is authorized to send for persons and papers, and from the language of the resolution creating the committee will have complete jurisdiction of every question necessary to the development of all the details of this story of official impropriety. It promises to be one of the most interesting investigations for many years, and will doubtless be far-reaching in its results.

Pan-Electric.

It was told in story, long ages ago,
That Pan was dead, and we thought so.
There were rhymes and romances written, we know,
Of the fate of the god who wrought so

Remarkable things with his hollow reeds,
And the world has wept at his "croaking;"
But the latest intelligence certainly leads
Us to think that the poets were joking.

For Pan is not dead—he is busy to-day
In important enterprises:
Electric business, the papers say,
Is just about what the size is.

But even in these United States
He brings from his native, far land
Æsthetic tastes, time not abates—
He has plucked himself a Garland. C.

—*New York World.*

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, March 1, 1886.

With the wind traveling at the rate of 84 miles an hour, it might be supposed that the various electrical services dependent on the use of aërial wires would be seriously interrupted. Yet this can hardly be said to have been the case here at any period of the past breezy week. In New York and Brooklyn the telegraph and telephone wires did suffer severely in some localities, with the result that long-distance communication was interrupted, but even that delay and damage was far less than might have been expected. As for the electric light wires, they defied the breezes about as well as a certain well-known flag that is said to have withstood them for a thousand years. In fact, I have heard many pleasurable expressions of surprise at the stability of the electric light circuits under such trying conditions. While I write the wind is still doing a rushing, go-as-it-pleases business at 30 or 40 miles an hour, but the wires everywhere now look in good shape.

All the same, keeping up the overhead circuits in such weather involves a heavy outlay, and the latest reports from outside New York detail great destruction of wires at more than one point, and the underground people have on the whole been supplied with some very cogent arguments by the champion gale of 1886. Anyhow, they seem pretty busy with orders in hand and estimates on new work. I found Mr. W. Callender last week in a complacent frame of mind over the reports from England of one of the most recent contracts of his company, in a place subject to high winds and where underground wires are in fact an absolute necessity—Cardiff Castle. I take the following from a clipping he showed me, out of the *Western Mail*, Feb. 1: "Altogether, 380 lights have been fixed, and so carefully has the work been accomplished that of the miles of wire laid in not a trace is left upon the walls. Every lamp, which can be turned on or off like a jet of gas, is fitted with a safety cut-out, which effectually prevents overheating of the wires. The machinery is located in the North road, where a commodious engine house has been erected, and the current is transmitted by heavily insulated Callender cables nearly 300 yards long. These are carried along the face of the castle walls and enter the building through the square tower at the entrance gate, and from thence along the corridor connecting the entrance tower with the residental portion of the castle." The final trial is said by the paper to have been made "with most satisfactory results." Mr. Callender told me also that Mr. W. H. Massey, electrician to the queen, having some time ago fitted up Buckingham Palace for incandescent lighting, has now, in view of the success achieved, been given instructions to increase the plant very largely. Callender cables are to be used.

The Vitrite and Luminoid Company, whose temporary offices are at 14 Dey street, have put out an interesting circular in which, by the aid of some tables from the tests of the Franklin Institute, they make a very strong showing for their incandescent lamp, lately known as the "White" and now styled the "Luminoid." This lamp was only run some 300 hours, being entered late, but during that time it showed a gain of 12½ per cent. of illumination. A good deal will be heard about that lamp before long. Great things are being predicted for it.

I saw recently some of the work done by Mr. E. W. Hazazer, 32 Frankfort street, this city, for Weil & Zigler's apartment house, Montague street, Brooklyn. He manufactures burglar alarms, annunciators and bells of his own design, and in this case has made the best use of the opportunity for showing the merit of his work. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, Mass., March 1, 1886.

The recent terrific gale of wind which has prevailed throughout New England has proven very disastrous to the wires of all the telegraph, telephone and electric light systems, but the recuperating facilities of these enterprises are shown in the fact that they had—with few exceptions—communication restored in a very short time.

A highly interesting book on electricity, entitled "Electric Railways and the Electric Transmission of Power," written by Robert Luce, will, I understand, be published shortly. The book will treat in a comprehensive way of what electricians have actually accomplished in the field of transmitting power by electricity. The electric railways now in operation and others in contemplation are described and illustrated.

On Thursday, Feb. 25, the Joint Standing Committee on Street Railways of the town of Winthrop, Mass., inspected the proposed route of the Enos Electric Railroad Company, and they have reported favorably.

The Benedict & Burnham Manufacturing Company, of Waterbury, Conn., have removed their Boston office to No. 24 Oliver street. The new quarters of this old and progressive corporation are larger and more conveniently located than those previously occupied.

The Redding Electrical Company, No. 30 Hanover street, this city, is having a heavy run on its electric call bells. This company recently reduced the price on a number of old-style, but withal a fine grade of hotel and house annunciators, for the purpose of quickly disposing of same to make room for an improved style of this line of goods. Mr. Jerome Redding, the treasurer of the company, reports the recent addition of new facilities to the department for the manufacture of dynamos and all kinds of experimental work for inventors.

Messrs. Frenyear & Razee, whose Boston headquarters are 352 Washington street, with factory at Exeter, N. H., are the Eastern agents for the "Sunlight" carbons for electric lighting. This firm are doing a very extensive business in their luminous goods. They are also agents for the Campbell electric wire, which "gives satisfaction wherever used." A catalogue of general electric light supplies will be issued this week by this firm, and can be had on application.

The Judkins Railway Train Signal Company has finished the equipping of the Maine Central Railway, and the officers of the road are satisfied with the working of the apparatus.

The Washburn & Moen Manufacturing Company, Worcester, Mass., reports business as being satisfactory. This corporation is about advancing the wages of its employés ten per cent.

The late superintendent of the telephone exchange of Worcester, Mr. Paul W. Bossart, has received a handsome present from his former associates in the shape of a diamond scarf pin, as a token of their respect and esteem. Mr. Bossert has been appointed to a responsible position with the Edison Company.

The Arlington Mills, Lawrence, have two of the Emerson Power Scale Company's cotton mill scales, one of the No. 2 shaft scales, and have also placed one of the No. 3 shaft scales upon a line of shafting, this week, to ascertain the amount of power required to drive the dynamos for furnishing electric lights. This may presage a brilliant future for the Emerson Power Scale Company. It is as necessary for manufacturers to know the cost of power consumed as any other part of the producing of manufactured goods, and those renting or hiring power cannot afford in justice to themselves to be without some such appliance.

At Salem, Mass., the Committee on Electric Lights have presented a report recommending the location of 63 additional electric street lights, and that these seventy-five lights shall burn from dusk to daylight. The estimated cost is as follows: For seventy-five arc lights of two thousand candle power, to burn 365 nights in the year at 58 cents per light per night, $15,877.50; for poles, cross bars, hoods, etc., $1,150; total, $17,027.50. The total cost of the Light Department for 1885 was $21,534.07, which, with the estimated cost of seventy-five electric lights, would be increased to $38,561.15. The committee finds that seventy-five electric lights, as located, would obviate the necessity of lighting 255 gas and 78 oil lamps, the present cost of which is $7,000. Deducting this from the gross cost as an offset, the net cost of the electric light is found to be $31,561.51. The $1,150 is the first cost of the poles and appliances, and will not occur again, and the subsequent cost will be $30.411.57. The present cost of lights with the electrics is $24,197.07 and the added cost with the electric lights proposed would be but $6,214.50.

William A. Harris, builder of the Harris-Corliss steam engine, Providence, has orders for engines from a large number of manufacturers and others.

The Municipal Signal Co. held its annual meeting at Portsmouth, N. H., Thursday, Feb. 25, at which the following directors were elected: George W. Gregory, Willard White, Charles N. Barnard, John C. Wilson, Albert A. Pope and Thomas Roche, of Boston, and Charles C. Randall, of New Bedford. This corporation owns all the patents of John C. Wilken, relating to police signaling, and will shortly place their police signal system in one of the police precincts of Boston.

The new engine of 65 horse-power, Armington & Sims make, has arrived at Woonsocket, R. I., and been placed in the new building on Bernon street for the Electric Light Company. The company will increase their capacity by a dynamo of 42 arc light power and another of a capacity for 360 incandescent lights. W. I. B.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
PHILADELPHIA, March 1, 1886.

The gale of the past week was very damaging to aerial electrical wires in this neighborhood, and in many instances rendered their use impossible. All telegraphic business was greatly delayed, and it was with great difficulty communications were at all had. Local telephone exchanges had great trouble in transacting business. City wires were in many places broken by signs and awnings falling on them, and in many places where the wind had a clear sweep, poles were blown down. The underground people feel that the old maxim "'tis an ill wind that blows no one good" is applicable for them in this case. Where electric light wires were broken and sparks came from each broken part, people congregated expecting to see some fun. The wind reached a velocity of 47 miles an hour in the city. No accurate estimate can be given of the damage done, but it is thought to be very large.

S. S. Applegate is busy in his factory in Camden, making his patent burglar proof matting. These goods are very highly recommended for their efficiency. Mr. Applegate has established an office for the benefit of the city trade, and those visiting the city desiring to see the workings of the mats can do so at 1,512 Chestnut street.

While in Baltimore during the past week, I was shown some very complimentary letters by Mr. A. G. Davis, President of the Viaduct Manufacturing Company, as to how their goods are liked by those who use them. The letters were from some of the largest telephone companies in the country. This company, from its long experience in the manufacture of telephone goods, has acquired an enviable reputation in that line.

The electrical factory of Mr. Morrison is very busy and is compelled to work overtime to keep pace with orders, which are continually increasing. The systematic way in which these works are conducted make it a pleasure to be in and about them. Each floor is a special department, and there is no mixing of work. The basement is devoted to storage, the first floor to making dynamos and motors, the second floor to astronomical instruments and the supply department. The next floor is devoted to making electrical instruments, such as ammeters, galvanometers, etc. The fourth floor is to be used for testing the different goods before permitting them to go out into the market. Mr. Morrison used great judgment, both in the construction of this factory and the employing of proper workmen. The works are under the supervision of Mr. H. E. Fleming and D. C. Davis, two gentlemen who have had large experience in the business. In this factory has just been completed a telephone receiver and transmitter, under the patents of Dr. Turnbull, which gives evidence of astonishing power as a long-distance "phone."

Mr. Wm. Hunt, of the firm of Poole & Hunt, reports business as good, and thinks it shows indications of increasing as spring approaches. This firm has never experienced a dull spell. While other manufacturers have been idle, they have been running full time. Their shafting and pulleys are being used largely by electric light companies in all parts.

S. F. Williams is the manufacturer of a high-speed engine which is especially adapted for electric light purposes. E. F. I.

ERIE, Pa., Feb. 20, 1886.

The annual ball of the telegraph operators of the L. S. & M. S. R. R. came off at this place on the 18th inst. The telephone people at Cleveland, Buffalo and intermediate towns, as well as a large number of the young people who do not handle electricity, were guests of the telegraph operators. An immense hall was filled with those who participated in the dancing. Wires were run and offices opened in the hall connecting with the lines of the W. U. Tel. Co., the B. & O. Tel. Co. and with the telephone lines of the N. Y. and Pa. Tel. & Tel. Co. Messages of regret were received from all parts of the United States from those who were unable to accept invitations. The affair was a grand success.

The Brush Electric Company at Cleveland are, I hear, calling in their storage batteries for remodeling.

The Manager of the Erie Exchange District is delivering lectures in this locality on the subject of electricity, and is drawing good crowds in every place where he speaks. The object is to excite an interest in the subject of electricity, and especially to show the advantages of the telephone.

The Erie County Light Company are rapidly extending their plant in this city. They use the Brush system.

Here is something that I wish some electrician or practical telephonist would explain: Two wires run parallel, say 15 miles to a certain point, from a certain exchange, and one is connected with an instrument at that point; the other extends say 15 miles further to another instrument. The subscriber at the point 15 miles distant wishes to talk to the subscriber 30 miles distant and calls the central and is connected through the exchange. It is with difficulty that the conversation is carried on. In fact by grounding both lines in the central better results are obtained by induction. Either line on a direct wire would work say 90 miles. Can it be upon the principle that currents running in opposite directions repel each other? Is there any remedy for the "trouble"?

General Manager McKinstry, of the Erie Telephone Company, was in Cleveland on the 18th inst. He stated to your correspondent that many of the toll lines of the company in Dakota and Minnesota are being abandoned on account of a failure to pay. He also stated that many small exchanges are being "pulled" for the same cause. The business, however, on the larger exchanges he reported as rapidly increasing. In Texas he reported the business as in splendid condition and growing satisfactorily. Small exchanges everywhere seem to be in disgrace.

CANADIAN NOTES.

BRANTFORD, ONT., Feb. 17, 1886.

The electric light plant here is of the Ball system. The circuit measures 8½ miles, Nos. 5 and 6, B. & S. gauge. The two machines weigh 780 lbs. each, and are run by water-power. They furnish 44 arc lights of 2000 candle-power each. Nearly all the lights are inside, paid for by private parties, a few being used on the street. The city owns about a quarter of the gas stock, but it is not unlikely that it will soon close a contract for some street electric lighting. The plant has now been running successfully since the latter part of June, 1885. The Ball Company are about to install another plant at Guelph, of 40 lights.

THE TELEGRAPH.

A New Messenger System.—The Porter Electric Messenger Company, New York City, is announced. Capital stock, $100,000. James Hepenstall is one of the incorporators.

Western Union Taxes.—The State of Pennsylvania has now brought a claim against the Western Union Company for taxes on capital stock and gross receipts. The total amount said to be due is $130,000.

T. M. B. A.—Assessment No. 195 has been made for March, of $1, to meet the death claims of C. B. Fairgrieve, O. D. McRae and J. H. Meehan. With the assessment slip goes a copy of the highly commendatory report made by the New York State Examiners and printed a few weeks ago in our columns.

A New Australian Cable.—Sir Alexander Stewart, ex-Premier of New South Wales, and Randolph C. Want, a large shareholder in the Mackay-Bennett Cable Company, left San Francisco, on Feb. 26, in a special car for New York on their way to London. Both these gentlemen are interested in the project of constructing a cable between this country and Australia.

"The Telegraph in America."—Mr. James D. Reid informs us that he designs issuing an edition de luxe of the above book prior to the publication of the main edition. The price of this superior edition will be only $5 cash and it will be limited to 200 copies. It will be in Russia and well mounted. Orders should be sent to the author at once, accompanied by the price.

The Edison Railway System.—This system, to communicate between fixed stations and moving trains, is about to be applied to the St. Paul Railroad between Chicago and Milwaukee. George C. McGregor, manager, accompanied by Electricians Rudd and Dingle, left New York for Milwaukee on Feb. 25, taking with them enough machines for two stations and four passenger trains. The battery has been greatly simplified. Dr. Crowell, president, estimates that the system will be self-supporting on the road if one passenger in twenty-five sends a fifteen-cent message a day.

Telegraph Lines Sold.—The telegraph lines and all other appurtenances of the Postal Telegraph and Cable Company within the boundaries of the State of Illinois were sold at auction in Chicago, on March 1. The sale was in pursuance of an order of the United States Circuit Court, and was made to satisfy a judgment rendered against the company in favor of Eugene N. Howell, of New York, amounting to $61,266. James L. High, attorney for Mr. Howell, tendered the only bid, becoming the purchaser for $25,000. The only other person present was E. A. Kent, who came from New York to represent the company. The sale was made subject to a priority lien for $10,000,000 held by the Farmers' Loan and Trust Company.

The Western Bucket Shop War.—H. H. Peck, of Kansas City, files a bill in the Chicago Circuit Court, praying for an injunction against the Board of Trade of Chicago, the Western Union Telegraph Company, and the Board of Trade Telegraph Company to prevent them from cutting off his market quotations. He sets up that he is in the grain and produce business, which will be almost, if not quite, ruined by the withholding from him of the quotations. He avers that the Board of Trade has connived and colluded with the telegraph companies under the specious plea of preventing illegal trading through bucket shops, etc., to force men in the grain business to pay the Chicago Board of Trade $10,000 for the quotations and the privilege to do business. Judge Moran has granted a temporary injunction.

Southern Litigation.—In the United States Court at Atlanta, Ga., on Feb. 10, the case of O. A. Lochrane against the Southern Telegraph Company came up. The suit was instituted by Lochrane to collect $30,000 of bonds, and the struggle was to get rid of this litigation by absorbing it in a suit brought by General Mahone and others in Virginia. The suits filed elsewhere greatly complicated matters. Decrees in Virginia and Georgia appointed separate masters. Exceptions were made to the master's report in Georgia, and the effect of the decree in Virginia in regard to certain bonds which had been presented to the master in Georgia and had been found by him valid after their rejection in Virginia, of which the master in Georgia had no notice. Judge McCoy sustained the exceptions, reserving the right to the holders of the bonds in Georgia to present them to the court in Virginia. Meantime, exceptions as to Lochrane's bonds were withdrawn.

THE TELEPHONE.

Tennessee.—It is said that about $4,500 will be spent in effecting telephonic communication between Rogersville and Bull's Gap, and Loudon and Kingston.

Another Company.—The Strong Telephone Company has been incorporated at Chicago, by W. P. Black, H. C. Strong and E. H. Reed, with a capital of $200,000.

The Cushman Telephone.—The American Cushman Telephone Company, capital stock $500,000, has been incorporated by Chas. N. Bolden, George W. Hotchkiss and Charles D. F. Smith. The objects are said to be the manufacture, use, sale, lease, etc., of telephone and telegraph instruments and apparatus.

The Telephone in Massachusetts.—The legislative committee on Mercantile Affairs, Massachusetts, gave a hearing on Feb. 23 to parties desirous of telephone reforms. The ever-active Senator Lilley revived his scheme for putting telephone companies under direct State supervision. Other speakers wanted lower rates.

An Old Acquaintance.—The McDonough Telephone Company has been incorporated for the purpose of owning and operating telephone and telegraph wires and instruments in all parts of the United States. Its capital stock is $5,000,000, divided into $50,000 shares, which are held in equal parts by George W. Beavers, John E. Boudin and Edmund B. Rose.

Instruments in Demand.—The output of instruments by the American Bell Telephone Company for the month ended Feb. 20 was:

	1886.	1885.	Increase.
Gross output	3,223	1,958	1,265
Returned	1,408	2,552	*1,144
Net	1,815	*594	2,409

* Net loss.

At It Again.—A dispatch of Feb. 23, from New Orleans, says: The celebrated telephone case was resumed in the United States Circuit Court this morning, Judges Pardee and Billings presiding. The counsel representing the contestants were on hand, and seemed refreshed by the intermission in the trial which has occurred. New and novel instruments had been added to the collection of telephonic apparatus, and a conspicuous feature was a large blackboard, which had been erected on a stand in front of the judges' bench, upon which the ingenious counsel will illustrate and demonstrate their scientific propositions. It is probable that the argument of Mr. J. R. Beckwith will occupy a week, for it is understood that he will develop the whole philosophy of sound transmission by electrical currents. Mr. Beckwith opened for the National Improved Company, and spoke two hours on the subject of the functions and mechanism of the human ear, illustrating his remarks by a huge plaster of Paris representation of the ear.

THE ELECTRIC LIGHT.

Asheville, N. C.—It is said that an electric lighting plant is to be put in at a cost of $12,000.

Coatesville, Pa.—The Citizens' Electric Light Company has been incorporated with a capital of $15,000.

The Gibson Electric Light Company of New York has been incorporated, with a capital of $100,000.

Baltimore, Md.—The Hochhausen Electric Light Company, capital stock $300,000, has been incorporated at Baltimore.

Cottage City, Mass.—The gas company of Cottage City, Mass., has petitioned for the right to add electric lighting to its business franchise.

Comprehensive.—The Bay City Natural Gas, Oil, Fuel Supply and Electric Light Company, of Sandusky, O., has been incorporated; capital, $25,000.

Danbury, Conn.—The Danbury Schuyler Electric Light Company has been incorporated by L. C. Holly, H. Berne and others, with a capital of $75,000.

Renovating a Plant.—The changes in the electric light plant at the Third Avenue Theatre, this city, including a new engine room, etc., have all been completed.

The Swan Company.—The annual meeting of the Swan Incandescent Electric Light Company will be held at the offices, 208 Elizabeth street, this city, on March 9.

Mobile, Ala.—The Police Board of Mobile has contracted with the Brooklyn Electric Construction Co., of Brooklyn, N. Y., for an electric light plant to cost $19,500.

With the Tide.—The Lafayette, Ind., Gas Company has asked permission of the Legislature to amend the charter, so as to allow the manufacture of electric light.

Youngstown, O.—The Mahoning Electric Light Company, Youngstown, O., has been formed with a capital stock of $40,000. Thomas H. Wells and others, incorporators.

Germantown, Pa.—A block of new dwellings and stores, three story and attic, are to have electric lights and electric bells. The architects are G. W. Mock & Co., of New York and Philadelphia.

Zanesville, O.—The City Council has authorized a contract with the Western Electric Company, of Chicago, for lighting the Sixth and Fifth street bridges with seven electric lights.

Erie, Pa.—The Edison Electric light and power company, of Erie, Pa., has been incorporated, with a capital of $60,000. M. E. Taylor, of Erie, is treasurer. The greater part of the stock is held by local owners.

Reading, Pa.—The Reading Electric Light Company, of Reading, Pa., is providing a new building, with ground floorage of 32x130 feet. It will have a dozen engines in its plant, aggregating several hundred horse-power.

Neillsville, Wis.—The Electric and Water Supply Company, capital stock $6,000, has been incorporated by R. F. Kountz, E. M. McConnell, and Jas. O'Neil. It is proposed to establish an electric light plant and to operate waterworks.

Chicago, Ill.—The Hyde Park Electric Company, capital stock $10,000, has been incorporated by Oswell A. Bogue, John F. Henkle and James C. Hyde, to manufacture and sell electricity for furnishing power, light and other purposes.

City of Mexico.—The City of Mexico Electric Light and Power Company has filed articles of incorporation in the Camden, N. J., County Clerk's office. The incorporators are Oliver Watson, R. H. De Bergne and George H. Mears. The capital stock is $100,000.

The Zipernowsky-Deri System in Rome.—An installation, including the use of 12,000 lamps, varying in candle-power, is to be put down in Rome. The system employed is to be the Zipernowsky-Deri, and Messrs. Ganz & Co. have charge of the work; 1,500 lamps are to be in position by next May.

The Van Choate Electric Light Company has been incorporated in this city with a capital of $5,000,000, divided into 50,000 shares. Its incorporators are Alexander C. Cary, Henry Belden, Robert N. Woodworth, Henry E. Parsons, George F. Johnson, Howard B. Woodworth and Arthur H. Lowerre.

Bolton's Electrical Fountain.—Sir Francis Bolton, the English engineer, has made a contract with Mr. Erastus Wiman for the sale of patents and rights of exhibition in the United States of his electrical fountain. The fountain will be one of the features of the Staten Island Amusement Company this summer.

Fatal Carelessness.—About 7 P. M., on Feb. 28, as Hugh Oliver, aged 23, an employé of the Evansville, Ind., Electric Light Company, was at work replacing a screw on the arc dynamo with his right hand, the screw slipped and the man, in endeavoring to catch it, placed his left hand also on the dynamo. The current passed through his body, killing him instantly.

Cambridge, Mass.—The Cambridge Electric Light Company, capital stock $60,000, has been incorporated by John E. Burgess, President; Geo. A. Burgess, Treasurer; Porter A. Underwood. Object: manufacture, purchase and sale of machinery and apparatus for electric lighting, heating and power; erection and operation of machinery, lines and apparatus for the generation, transmission, and use of electricity for lighting, heating and power in the city of Cambridge.

A Tower Accident.—A dispatch of Feb. 25 from Detroit says: Shortly after 8 o'clock this morning, Alexander Rose, an employé of the electric light company, ascended a tower at the corner of Gratiot avenue and Mack street, for the purpose of replacing the burned-out carbons. He had just reached the platform at the top, when he suddenly fell over the railing and came down head foremost to the ground, a distance of 150 feet. His body was horribly mangled, and he lived but a short time after. He was 23 years of age and unmarried.

Cutting Ice by Night.—Mr. Fred. S. Palmer, superintendent of the Bangor Electric Light and Power Company, says: "I have put the electric light to a new use, and the ice men here say it is a grand success. I have set a 4 by 4 joist in the ice and run two miles of wire. I light up the ice field with three Thomson-Houston arc lights, and put one light in each ice-house and one on the wharf at the water end. The light is preferred to sunlight, for now that the sun is high the ice feels its effects, but the ice cut at night comes out much better. Altogether we are doing nicely; expect to increase our lights in the spring."

Wooster, O.—The contract for lighting the streets has been awarded to the Schuyler Electric Light Company, of Hartford, Conn. The special committee is more than pleased with the contract with the Schuyler Company, whose agent, Mr. J. R. Adams, of St. Louis, means business, as is fully demonstrated by his prompt action and quick work in the matter. He has leased sufficient room and the power at the old McDonald agricultural works, which will make first-rate headquarters. In less than forty days fifty lamps will be alight on the streets, that number having been contracted for. The poles and apparatus have already been ordered. Twenty lights have already been contracted for by the business men and but little soliciting has been done as yet in that direction.

Huntingdon, Penn.—A dispatch from the above place of Feb. 25 says: "Rival companies have been formed here for the purpose of supplying this city with electricity for light, heat and power, and to-day both published their notices of applications for charters. In one the applicants are E. S. McMurtrie, J. C. Blair, B. F. Isenberg, S. R. Shumaker and John D. Dorris. Their company is called "The Huntingdon Electric Light and Power Company," and they will ask the Governor for a charter on the 18th of April. The other is composed of wealthy and substantial citizens, whose names are not given, the notice being signed by R. Bruce Petrikin, their solicitor. They will apply for a charter under the name of "The Huntingdon Light and Heat Company" on the 19th of April. As it is not probable that the Governor will grant charters to two companies in this city for the same purpose, there will be a lively contest between them to determine which shall be given corporate powers. The Light and Heat Company will oppose the bestowing of the grant upon the Light and Power Company on the 18th of April, and will insist that the applications be considered together on the next day, when that of the former company will be made. It is not publicly known whether Peter Herdic has any interest in either of these companies or not, but he is here on the ground, and it is suspected that he is the moving power in one of them."

APPLICATIONS OF POWER.

The American Electric Power Company, of New York, has been incorporated, with a capital of $1,000,000. J. Amory Knox, of New York, Frank Siddall and B. K. Jamison, of Philadelphia, are the incorporators. The latter will probably be treasurer of the company.

The Mott Motor.—The Mott Electro Motor Company, of this city, has been organized with a capital of $1,000,000. The incorporators are S. D. Mott, Eugene Kelly, Jr., H. G. Henderson and P. Tucker. The offices at present are in Temple Court. The company will make, use and sell the motor.

PERSONALS.

Mr. James D. Reid has recently come into possession of a very interesting memento of Prof. Morse. It is an oval brooch that was found among the effects of the late Mrs. Lynde, who was a daughter of Morse. In it is a speaking daguerreotype of the great inventor taken about 1840, or just prior to the successful trial of his telegraph.

Mr. Albert L. Arey.—This gentleman, since resigning his position as manager of the Buffalo Electrical Works, about a year ago, has become Professor of Physics at the Rochester Free Academy, Rochester, N. Y., a large and well-known educational institution. He has a large laboratory with reading room in connection with his work.

Mr. Edison's Wedding.—A dispatch of Feb. 24 from Akron, O., says: The elegant home of Lewis Miller, President of Chatauqua and twice a millionaire by reason of his invention of the Buckeye mower and reaper, was to-day the scene of the Edison-Miller marriage. The ceremony took place at 3 P. M. in the presence of about one hundred and twenty-five guests. The company was limited to relatives and immediate friends. The bride, Miss Mina Miller, is one of the best known and best regarded, as she is one of the most beautiful of Akron's young people, and just eighteen years the junior of the great electrician. Dr. E. K. Young, pastor of the First M. E. Church, this city, solemnized the marriage. Mr. Edison's best man was Lieut. F. W. Toppan, United States Navy, of New York, and the bride was given away by her father. Mr. Edison's gift to his bride was a necklace of diamonds and pearls. Gifts of silver and gold and precious stones from relatives and friends made up a magnificent tribute of good wishes. Scores of congratulatory telegrams came from abroad. From New York there were in attendance Edward H. Johnson, Charles Batchelor, John Tomlinson, Samuel Insell, G. C. Sims, S. Bergmann and Charles P. Bruch, and others. Mr. and Mrs. Edison left to-night for Cincinnati, and will proceed thence to their winter home at Fort Meyer's, Fla.

MISCELLANEOUS NOTES.

A New Factory.—The Electric Manufacturing Company, Troy, N. Y., will erect a factory at Greenbush in the spring.

The Automatic Electric Current Arrester Company has been incorporated in this city with a capital of $100,000, by C. M. Gilbert, H. Wilbur and J. W. Purdy, Jr.

An Electro-Homœopathic Institute.—The Dr. Valentine Electro-Homœopathic Institute has been incorporated by J. C. Valentine, C. F. Blakely and S. S. Valentine to give instruction in electropathy and to deal in electrical appliances.

A New Factory.—It is reported from the Brooklyn Eastern District that the Edison people have bought a large block of property on North Ninth, Tenth, Eleventh, Fourth and Fifth streets, near Bushwick Creek, intending to build a factory there.

Grounds of Objection.—A plumber employed by A. W. Murray was severely injured by an electric current a few days ago, from a wire connected with plumbing pipes. This suggests that there should be some regulation prohibiting the practice of connecting wires with gas and other pipes for a ground communication, as is commonly done.—*Sanitary News.*

A Patent Case.—In the United States Circuit Court, Boston, Judge Colt has given a decree for a preliminary injunction in the case of Edward D. Libbey *vs.* Mt. Washington Glass Company *et al.*, which was a bill in equity alleging an infringement of letters patent No. 282,002, granted to Joseph Locke, July 24, 1883, for an article of glassware of ruby and amber colors, known as "amberina," and for the process of its manufacture.

Zinc.—L. l'Hote, in *Comptes Rendus*, says: As to the inquiry if zinc free from any foreign metals decomposes water either on boiling or in presence of dilute sulphuric acid, experiment proves that such is not the case. Pure zinc heated with distilled water in a flask, so arranged as to receive the gases over mercury, gives off no hydrogen on prolonged boiling. Nor is it attacked by dilute sulphuric acid. The presence of iron in proportions of from 3 to 5 in 100,000 enables it to decompose water. Traces of arsenic and antimony have the same effect.

Detroit Now, Cleveland Later.—The following is the letter referred to in our last issue, in connection with the choice of a meeting place for the N. E. L. A.:

BALTIMORE, February 12, 1886.

J. F. Morrison, President, Baltimore, Md.:

DEAR SIR: In behalf of the Brush Electric Company of Cleveland, I have been advocating the advantages of the Forest City for the midsummer meeting of the National

Electric Light Association. Understanding, however, that a cordial invitation has been extended by Mr. W. H. Fitzgerald, of the Brush Electric Light Company of Detroit, for the holding of the next convention in that place, and that there is a general wish to visit the Lake City that is entirely illuminated by means of Brush lamps and towers, I hereby express my cordial support of Detroit for the coming meeting. It will be a disappointment to many not to have the association assemble next at Cleveland, but it will doubtless be convenient and pleasant for numerous delegates to stop there in going or coming from Detroit, and we shall hope to have the honor of having Cleveland selected as the location of one of our later gatherings.

Yours respectfully, WM. F. SWIFT.

SPARKS AND FLASHES.

A Californian Discovery.—The electric light must go as a ball-room illuminator. It betrays too many secrets of texture and complexion. After all, the pale and melancholy moon is beauty's best friend.—*San Francisco Alta.*

Can He be Shocked?—When a man takes hold of an electric battery and the current is turned on, he can't let go, and it makes him squirm to hold on. Mr. Garland has a painful grip on the business end of the Pan-Electric battery.—*Fall River Globe.*

STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on the New York Stock Exchange, Boston Exchange and elsewhere are as follows:

Telegraph.—Am. Dist., b 30, a 35; B. & M., b 2¼, a 3¼; Western Union, b 72½, a 72⅝.

Telephone.—Am. Bell, b 147, a 148; Erie, b 26¼, a 27; New England, b 30, a 30¼; Tropical, b —, a—; Providence, b 120, a 121; Rhode Island, a 35.

Electric Light.—Edison, b 150.

BUSINESS NOTICES.

Volta-Pavia.—The Chemical Electric Light & Power Company, Boston, have taken the old stand of the Western Electric Company in that city, 109 Court street, as a factory, and are now very actively engaged fitting it up with a plant equal to 5,000 gallons of Volta-Pavia per week. The Western Electric Company will handle the solution and batteries for the company in New York and Chicago; and there is every evidence of a brisk and growing demand for what must be called the "Volta-Pavia system."

Pike's Toothache Drops.

Cure in 1 minute; harmless, quick, thorough; no equal; 25c.

DEAN'S RHEUMATIC PILLS are a prompt, sure cure; 50c.

HALE'S HONEY, the great cough cure, 25c., 50c. and $1.

GLENN'S SULPHUR SOAP heals and beautifies the skin; 25c.

GERMAN CORN REMOVER kills corns and bunions, 25c.

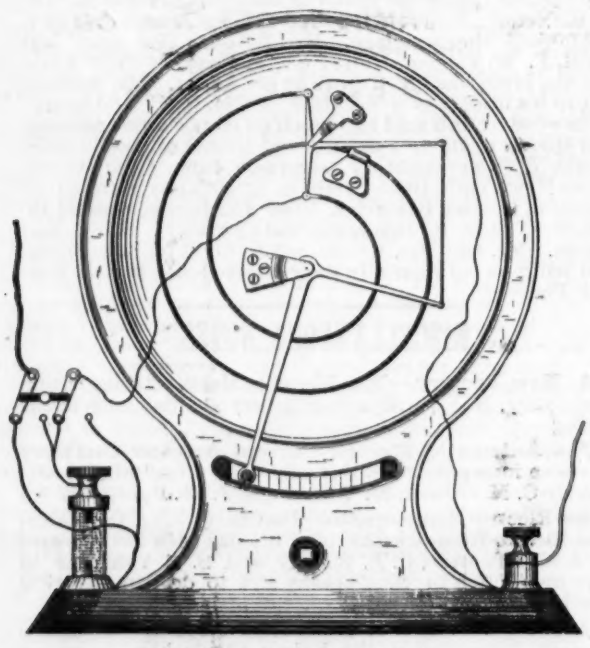
HILL'S HAIR AND WHISKER DYE, black and brown; 50c.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED FEBRUARY 16, 1886.

336,081, 336,082, 336,083, 336,203. Telephone Transmitter; Chichester A. Bell, Washington, D. C. The first is for a method and the others for apparatus for carrying out the method, which consists in causing the vibratory jet upon which the vibrations are impressed to act directly upon a current or charge of electricity—that is to say, the variations in the electrical conditions of the jet are made effective to produce variations in the flow or distribution of electricity in a conductor connected with said jet. If the jet were allowed to fall upon the diaphragm of an ordinary telephone transmitter, it would produce variations in the circuit controlled by said transmitter; but the action of the jet would be indirect and due to mechanical rather than electrical forces. The changes in the electrical condition of the jet are or may be utilized by including the vibratory jet, or rather a portion thereof, in a charged electric circuit, so that the resistance of the circuit is varied by the variations in the fluid conductor produced by the variations of the jet. A simple form of apparatus is shown in the cut.

336,087. Dynamo Armature; Charles F. Brush, Cleveland, O. It is composed of superposed layers of band-iron wound upon one another, the opposite faces of which are provided with radial grooves situated directly opposite one another and extending the entire width of the ring, the side walls of the grooves being made integral with the layers of the band.



336,183. ELECTRIC METER

336,095. Individual Electric Signal; Arthur W. S Davis, Lowell, Mass., Assignor to Frederick Taylor, of same place. Consists of an electro-magnet, a local battery, signal-bell apparatus in electrical connection therewith, and a switch-armature adapted to be operated by said magnet to close said local signal-circuit, and a stop-armature placed nearer to the pole-cheek of said magnet and adapted to be operated only by a greater current than is necessary to operate said switch-armature, and arranged to swing in a plane at right angles to the plane in which said switch-armature moves, so as, when operated, to be swung in the path of said switch-armature and between said switch-armature and said pole-cheek, and to arrest the motion of the same and to prevent the closing of said local circuit.

336,101. Active Material for Secondary Batteries; **336,102. Secondary Battery Electrode**; Ernest M. Gardner, Brookline, Assignor to James L. Little, Jr., Boston, Mass. 1. He mixes carbon and lead oxide in a paste with calcined magnesia, which is allowed to harden.

2. Consists of a metal supporting-plate containing an opening, and in said opening a series of shelves or ledges formed of the material of and integral with said plate, disposed one above the other, and each shelf or ledge extending in width beyond the thickness of the plate on both sides.

336,132, 336,133. Electric Meter; Samuel D. Mott, New York, N. Y., Assignor by direct and mesne assignments to the Schuyler Electric Light Co., of New York. 1. A current passing through a thermostat causes the index hand to indicate equivalent of heat in ampères. The device is shown in the cut.

2. He claims the combination for an electric meter with an electric motor driven by the current to be measured, and having a magnetic field for its armature, maintained constant despite changes in the current, of a register-train operated by said motor, and constituting by itself the load for said motor.

336,171. Incandescent Lamps; Merle J. Wightman, Hartford, Conn., Assignor to the Schuyler Electric Light Co., New York, N. Y. Has standards to which are fixed both the globe and the switch, the invention relating to mechanical details.

336,173. Telephone Transmitter; Sumner Tainter, Washington, D. C. Consists of derived inventions upon Chichester A. Bell's patents, described above.

336,510. ELECTRIC MOUTH AND THROAT ILLUMINATOR.

336,176. Arc Lamp; John Tregoning, Brooklyn, N. Y., Assignor to the Schuyler Electric Light Co., New York. The system is composed of a main circuit coil, a movable core therefor connected to the feed mechanism, and a high-resistance derived-circuit coil wound upon an extension of said core exterior to the main circuit coil and carried by the core.

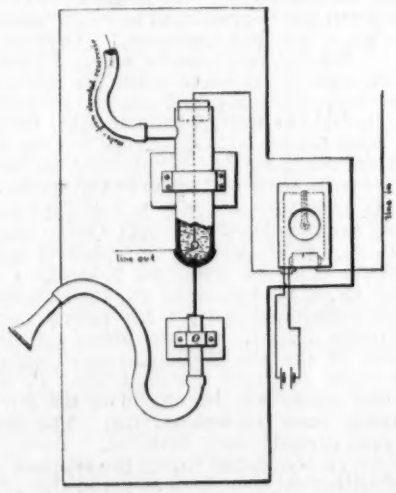
336,184, 336,503. Electric Arc Lamp; Addison G. Waterhouse, Hartford, Conn. The first consists of details. In the second, the feed-regulating magnet consists, as shown in the cut, of a movable magnet-core actuated by coils in the main circuit, and a high-resistance derived-circuit coil wound upon an extension of the core and moving therewith, and a bell-extension from the core arranged to surround the main-circuit coils, and acting in the combination to increase the power and delicacy of operation.

336,190. Automatic Railway Track Key; Charles W. Whited, Battle Creek, Mich., Assignor of one-half to W. H. Pettibone, same place. Relates to the giving of electric signals by trains while in motion; and consists of a circuit-governing mechanism connected with the rails of the track and operated by the weight of the train, said mechanism being so constructed and arranged as to be limited in its operation to the action of trains going one way only.

336,268. Telephone; Henry S. Thornberry, Boston, Mass., Assignor to the American Bell Telephone Co., same place. Consists in providing a containing-cell for the conducting particles, the interior of which cell is of such form that the electrical resistance is a minimum, while a slight vibration of the movable electrode produces an effective variation in resistance and a general displacement or movement of the confined conducting particles, whereby packing is prevented.

336,276. Insulator; John Wilson, New York, N. Y. He provides a transverse notch in the upper end, the walls of which notch are offset and form shoulders for seating and insulating two or more wires of different sizes one above another.

336,284. Learner's Telegraphic Instrument; Emmor Bonsall, Davenport, Iowa. It is adapted to produce the audible Morse alphabet, and consists of a frame having



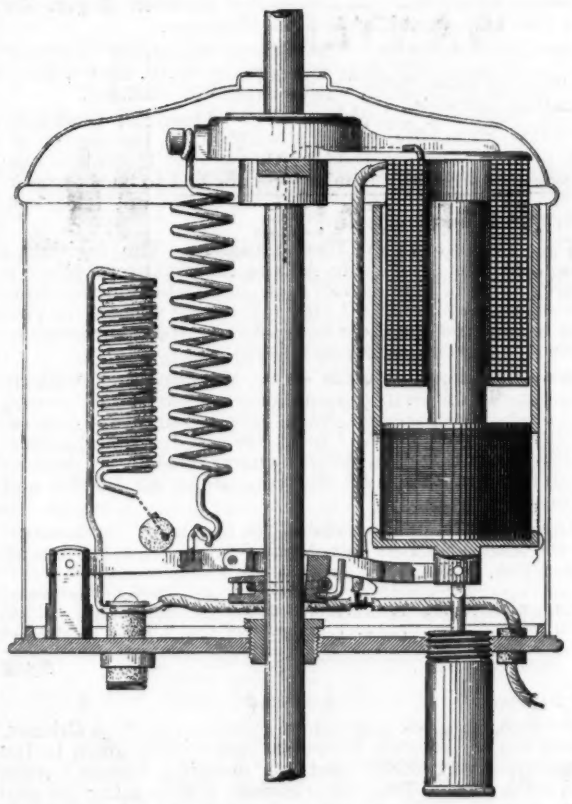
336,082. JET MICROPHONE OR APPARATUS FOR TRANSMITTING SOUND BY MEANS OF JETS.

spring-contacts connected with the circuit-wires and devices for pulling a slotted or recessed strip between the said spring-contacts, thus breaking and closing the circuit.

336,329. Mouth-piece for Telephone Transmitter; George L. Lavrey, East Boston, Mass. Consists of two hollow conic frusta united at their larger bases. It is adapted to the transmitter-case so as to screw therein, in order and in a manner to adjust it (the said mouth-piece) nearer to or farther from the diaphragm of the transmitter. In telephoning long distances the mouth-piece has frequently to be nearer the diaphragm to insure the necessary vibration of the latter.

336,352. Battery; Alexander H. Roovers and Alfred W. Roovers, New York, and Percy G. Williams, Brooklyn, N. Y. The zinc electrode is hollow, and has holes within the cell part and without the stopper of the cell to allow escape of gas.

336,371. Electric Light Tower; John S. Adams, Detroit, Mich., Assignor to the Detroit Iron Tower Co., same place. Consists of an open framework of vertical and horizontal sections provided with diagonal braces, the tower being triangular in cross-section and of similar sectional dimensions from top to bottom, and provided with a mast having projecting arms for supporting electric lamps, and with or without an interior elevator.



336,503. ELECTRIC ARC LAMP.

336,402. Extracting Iron from Grain; Frank E. Fisher, Detroit, Mich. Consists of improvements upon the ordinary mechanism for separating iron filings and chips from brass particles.

336,450. Electric Belt; Placito F. Valiant, Jefferson, Iowa, Assignor of one-half to Gillum S. Toliver, same place. The elements of the chain are connected to each other by a looped wire, which is attached to the copper plate by being passed through perforations therein, the looped end extending beyond the plate, while the opposite ends are bent upon themselves and lie parallel with each other, said ends being located on the inner side of the copper plate.

336,452. Arc Lamp. 336,453. Conductor for Electric Railways; Charles J. Van Depoele, Chicago, Ill. 1. Consists of improvement upon his patent 294,532, March 4, 1884. 2. Consists of details in electric railway systems of the class in which a suspended conductor furnishes an electric current of one polarity, and the rails form the other side of the circuit, whereby all danger of accidental short-circuiting or injury to persons and animals is entirely avoided, thereby more nearly fulfilling the conditions under which electricity can be advantageously used to propel cars in cities.

336,510. Electric Mouth and Throat Illuminator; Louis F. Criado, Assignor to Stout, Meadowcroft & Co., New York, N. Y. Relates to important details shown in the cut.

336,518. Electric Door-Pull; William Humans, Cambridgeport, Mass., Assignor to Gilman Collamore, Boston, Mass., and the American Magnetic Co., Jersey City, N. J. A worm-shaft geared to the pull and to the dynamo constitutes the invention broadly.